U.S. DEPARTMENT OF TRANSPORTATION

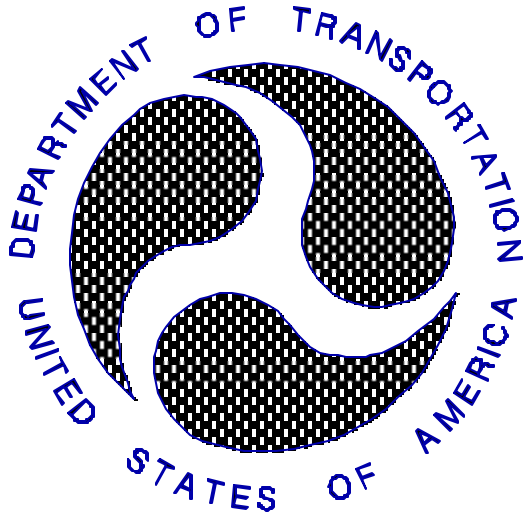
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

NEW CAR ASSESSMENT PROGRAM

FRONTAL IMPACT TESTING



December 1999

SAFETY PERFORMANCE STANDARDS
OFFICE OF CRASHWORTHINESS STANDARDS
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400 SEVENTH STREET, SW
WASHINGTON, DC 20590

FRONTAL NCAP LABORATORY TEST PROCEDURE

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1. PURPOSE AND APPLICATION

This laboratory test procedure provides the specifications for conducting New Car Assessment Program (NCAP) and Standard Enforcement Indicant Program 35 mph frontal barrier impact testing under a joint composite program sponsored by the following offices within the National Highway Traffic Safety Administration (NHTSA):

a. Office of Crashworthiness Standards
b. Office of Crashworthiness Research (OCR)

The contract laboratories are directed by this test procedure to use a special test parameter which is an impact velocity of 35 ± .5 mph (NOTE: This is 5 mph greater than the 29.4 ± .5 mph impact velocity specified for FMVSS Nos. 208/212/219/301). This increased impact velocity is specified in order that the NHTSA can obtain new car assessment and research data, and the 35 mph crash tests will be viewed as "indicant tests" for FMVSS Nos. 208, 212, 219 (Partial), and 301. The requirements of this indicant test procedure must be strictly adhered to; however, the test contractors are encouraged to suggest improved testing techniques to assist in procuring the required crash test data. Any changes to or deviations from this test procedure must be approved by the Contracting Officer's Technical Representative (COTR).

All NCAP vehicles shall be tested using all available restraint systems, whether active or passive.

Contractors are required to submit a detailed test procedure to the COTR before initiating the NCAP test program. The procedure must include step-by-step operations of the methodology to be used for the following (not inclusive):

-- Test vehicle acceptance from dealer or haul-away driver
-- Test vehicle inspection for pre-test data sheet information
-- Dummy configuration and performance verification
-- Instrumentation calibration and data processing
-- Dummy placement in vehicle
-- Dummy positioning in vehicle
-- Camera placement and check-out
-- Load cell barrier data collection
-- Vehicle brake-abort system
-- Vehicle tow and lateral guidance system
-- Test vehicle inspection for post-test data sheet information
-- FMVSS 208 injury criteria data/neck, pelvis, lower leg
-- Test vehicle security and storage
-- FMVSS No. 2-12 data

-- FMVSS No. 219 data
-- FMVSS No. 301 data
-- OCR data

The contractor's in-house test procedure must have NHTSA approval prior to conducting the first crash test of a particular fiscal year program. The contractor's test procedure cannot deviate in any way from the NHTSA procedure without the prior approval of the NHTSA COTR.

2. GENERAL REQUIREMENTS

2.1 REQUIREMENTS FOR THE OFFICE OF CRASHWORTHINESS STANDARDS

2.1.1 FMVSS 208

The NCAP test procedure is based on the FMVSS # 208 test procedure except for (not inclusive) an increased impact speed, the use of all available restraints, incorporation of a load cell barrier, and recording of seat belt performance data, pelvic acceleration, lower leg injury measures, foot accelerations, and the use of redundant head and chest accelerometers. All data acquisition and processing shall be in accordance with the current SAE recommended practice J211, "Instrumentation for Impact Testing", **APPENDIX I**. The Contractor Furnished data acquisition and processing system shall be tested and satisfy the"qualification test" specified in **APPENDIX F**.

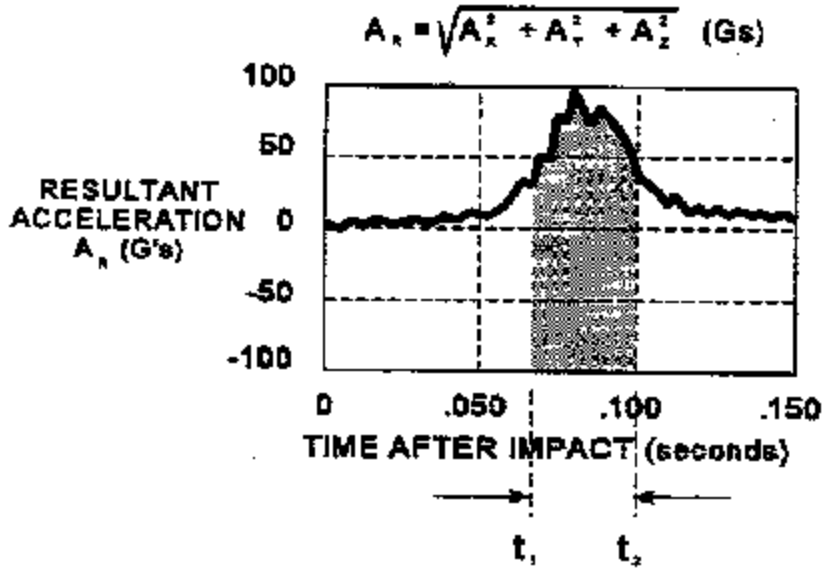
OCCUPANT CRASH PROTECTION requirements are specified in terms of head and chest accelerations and upper leg axial forces measured an laboratory calibrated Part 572 Subpart E dummies in barrier impact collisions as shown below:

-- Head Injury Criterion (HIC) -- (FMVSS 208 - cannot exceed 1000 HIC)

$$HIC = \left[\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} A_R dt \right]^{2.5} (t_2 - t_1)$$

where $A_R = [A_x^2 + A_Y^2 + A_Z^2]^{1/2}$ Resultant Acceleration magnitude in g units at the dummy head c.g. as shown in Figures 1 and 2

t_1 and t_2 are any two points in time during the impact event which are separated by not more than a 36 millisecond time which would maximize the HIC integration.



Chest Criterion-- (FMVSS 208 - cannot exceed 60 G's)

The maximum peak resultant acceleration at the dummy's chest center of gravity over a 3 millisecond interval.

Chest deflection - (FMVSS 208 - cannot exceed 76.2 mm)

Femur Force Criterion-

The compressive force transmitted axially through each upper leg or femur - (FMVSS 208 - cannot exceed 10008 Newtons)

2.1.2 FMVSS 212

This standard establishes windshield retention requirements for motor vehicles during crashes. Vehicles equipped with passive restraints must retain 50 percent of each side of the windshield on each side of the longitudinal centerline after they are subjected to a 30 mph frontal barrier impact. Vehicles not equipped with passive restraints must retain not less than 75 percent of the windshield during the 30 mph frontal barrier impact.

2.1.3 FMVSS 219 - - Partial

This standard specifies limits for the displacement of vehicle components into the windshield area during a crash.

	In "Protected Zone"	Below "Protected Zone"
Vehicle Component Penetration	Maximum of 0.25 inch into template	Must not penetrate inner surface of windshield

The word "partial" is used since the Std. 219 Styrofoam windshield protected zone template has been eliminated for all NCAP 35 mph frontal impact tests in order that the forward motion of the driver and passenger dummies can be filmed through the vehicle's windshield. However, the lower boundary of the protected zone shall be marked on the windshield glass which accounts for a partial standard test.

2.1.4 FMVSS 301

This standard specifies requirements for the integrity of motor vehicle fuel systems.

A. Frontal Impact - -

TIME	MAX. FLUID SPILLAGE
From impact until vehicle motion ceases	1 ounce by weight
For 5 minute period after vehicle motion ceases	5 ounces by weight
For the next 25 minutes	1 ounce by weight/minute

B. Static Rollover - -

TIME	MAX. FLUID SPILLAGE
For 5 minute period from onset of rotation at each 90E position	5 ounces by weight
For 6th minute	1 ounce by weight
For 7th minute (if required)	1 ounce by weight
For 8th minute (if required)	1 ounce by weight

2.1.5 NCAP SPECIFIC

Front seat belt performance data including lap and shoulder belt loads, belt stretch, and spoolout.

High speed film documentation

Interior compartment intrusion dimensional data

Redundant head and chest accelerations

Pelvic accelerations

2.2 Requirements for the Office of Crashworthiness Research (OCR)

Load Cell Barrier shall be installed and instrumented for each test (Full Frontal Barrier Test Only).

Data shall be collected, reduced and processed from the 36 barrier face load cells (Full Frontal Barrier Test Only).

Data shall be collected, reduced-and processed from nine uniaxial accelerometers mounted at specified location on the test vehicle.

Data shall be collected, reduced and processed from the neck six-axis load cell.

Data shall be collected, reduced and processed from lower leg instrumentation.

Data shall be collected, reduced and processed from foot accelerometers.

Test vehicle pre-test and post-test dimensional data.

2.3 Requirements for the National Center for Statistics and Analysis, Accident Investigation Division (AID)

Test Vehicle post-test damage description as shown in The Sample Test Report.

SIGN CONVENTIONS FOR
PART 572 SUBPART B AND E TEST DUMMIES

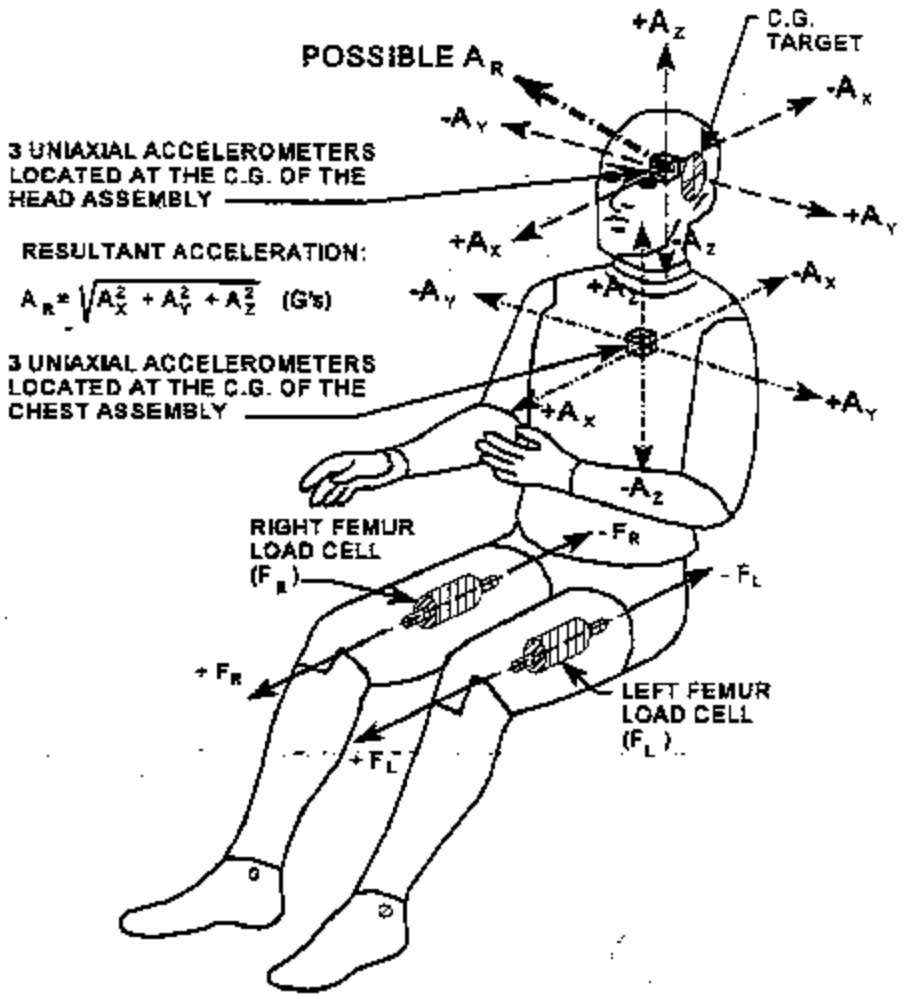


FIGURE 1

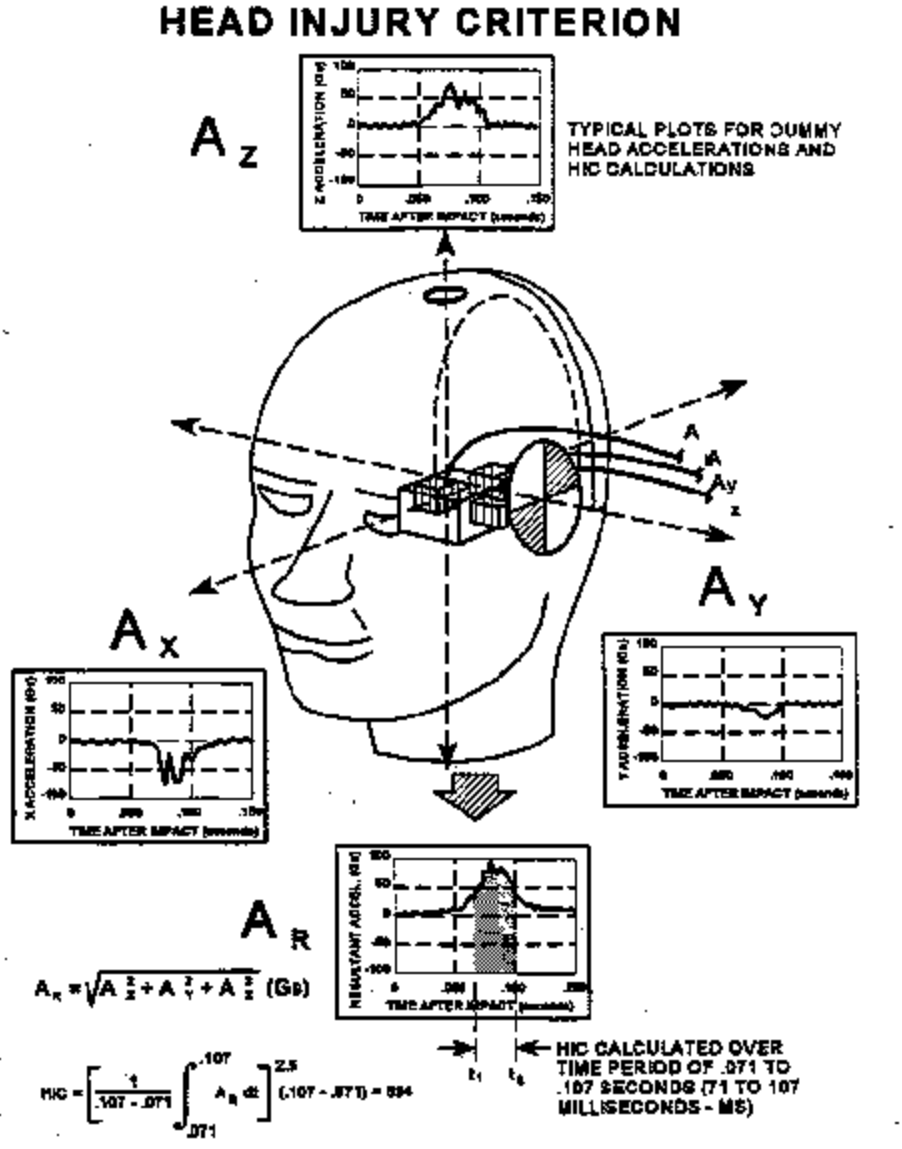

HEAD INJURY CRITERION
A z
TYPICAL PLOTS FOR DUMMY HEAD ACCELERATIONS AND HIC CALCULATIONS
A x
A y
A R
A R = √(A x² + A y² + A z²) (Gs)
HIC = [1/(.107 - .071) ∫ from .071 to .107 A R dt]^2.5 (.107 - .071) = 694
HIC CALCULATED OVER TIME PERIOD OF .071 TO .107 SECONDS (71 TO 107 MILLISECONDS - MS)

FIGURE 2

3. SECURITY

The contractor shall provide appropriate security measures to protect NCAP test vehicles, dummies, load cell barrier and any GFE during the entire crash test program, and shall be responsible for all equipment removed from test vehicles before and after the crash test. Vehicle equipment thefts or act of vandalism must be reported to NHTSA authorities immediately. Under no circumstances shall any vehicle components be removed during a visitor inspection unless authorized by OCS engineers. All data developed from the crash test program shall be protected.

NO INDIVIDUALS other than the contractor's personnel directly involved in the crash test program shall be allowed to witness a 35 mph frontal barrier impact test, inspect, photograph or video tape any test vehicle unless authorization is granted by a representative from the OCS. It is the contractor's responsibility to secure the test site area during a test and to shield the barrier impact area from the public view by the use of canvas or other blocking devices.

Rules for Contractors

1. No vehicle manufacturer's representative(s) or anyone other than the contractor's personnel working on the NCAP Contracts and NHTSA personnel, shall be allowed to inspect NHTSA vehicles or witness vehicle preparations and/or crash testing without prior permission of the Office of Crashworthiness Standards (OCS). Such permission can never be assumed.

2. All communications with vehicle manufacturers shall be referred to the OCS, and at no time shall the contractor release crash test data without the permission of the OCS.

3. Unless otherwise specified, the vehicle manufacturer's representatives shall only be authorized to visit the contractor's test facility on the day that the test is scheduled, and the representatives must be escorted by NHTSA and/or contractor personnel.

4. Test vehicle inspection by the vehicle manufacturer's representative(s) shall be limited to 30 minutes prior to the start of vehicle impact test. Post-test inspection shall be limited to 1 hour after contractor personnel have completed their test tasks.

5. Photographs and videotapes of the test vehicle, associated test equipment and test event shall be allowed. However, test personnel shall not be included in any photographic coverage, and videotaping of vehicle preparation must be approved by OCS. The contractor's personnel shall not respond to any questions from the manufacturer's representatives regarding NCAP. All questions shall be referred to the COTR, an OCS representative present at the test site, or to OCS.

6. VISITATIONS -

The contractor shall permit public access to and inspection of the test vehicles and related data during the times specified by the NHTSA COTR. NHTSA shall advise interested parties that such access and inspection shall be limited to a specified day, and specified hours and require prior approval from the Office of Crashworthiness Standards. The contractor shall refer all visit requests from vehicle manufacturer's representatives and consumers to the Office of Crashworthiness Standards. This service shall be included as an incidental part of the crash test program and will not result in any additional cost to the NHTSA. The contractor shall make his own arrangements with interested parties for expenses incurred beyond providing access and inspection services. All inquiries by manufacturers concerning the NCAP (vehicle, procedures, data, etc.) shall be directed to OCS representatives.

4. GOOD HOUSEKEEPING

The contractor will maintain the entire test area including the tow road, area around barrier, vehicle pre-test preparation facility, instrumentation building, and dummy configuration and performance verification test laboratory in a clean, organized and painted condition. All test instrumentation must be setup in an orderly manner consistent with good engineering practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall commence crash testing within four (4) weeks after receipt of the first test vehicle. Subsequent crash tests will be conducted, if requested, at a minimum of one (1) vehicle crash test per week. The NHTSA COTR will make adjustments to the crash test schedule in cases of unusual circumstances such as inclement weather or difficulty experienced by the Agency in the procurement of a particular vehicle make and model. All testing shall be coordinated to allow monitoring by the COTR.

6. TEST DATA DISPOSITION

The contractor shall make all crash test data available within two hours after the crash test event if so requested by Agency personnel. Under no circumstances shall this data be furnished to non-Agency personnel. The contractor shall analyze the preliminary test results as directed by the COTR.

6.1 Computer Data Tape and Final Hard-Copy

The contractor shall deliver to OCS the final data tape/diskette, digital printouts, and plots within One (1) week after the crash test.

6.2 Test Report

6.2.1 NEW CAR ASSESSMENT PROGRAM test report shall include all of the items shown in the Sample Test Report. The contractor shall submit 7 CD's and 3 paper copies of the NCAP test report to the following address:

U. S. Department of Transportation
National Highway Traffic Safety Administration
Safety Performance Standards
Office of Crashworthiness Standards (NPS-10)
400 Seventh St., S.W., Room 5313
Washington, DC 20590

6.2.2 Report Submission

All final test reports shall be submitted to the above listed NHTSA office within **four (4) weeks** from the date of the vehicle crash test.

NCAP data shall be submitted in **METRIC** format according to the specifications contained in **APPENDIX G**.

6.2.3 Text/Data Sheet Disk

The contractor shall submit **1 (one)** diskette of the text and data sheet portion only of the test report in Word Perfect format within **four (4)** weeks from the date of the vehicle crash test. The full test report including photographs and data traces on a disk may be a future requirement.

6.3 Test Film

OCS shall receive **five (5)** copies of the 16 mm color movie film for each crash test, and the film copies shall be mailed directly to the OCS within **four (4)** weeks of the vehicle crash test. The master print for each of the crash test films shall be retained by the contractor, but will be made available to the OCS upon request.

6.4 Data Loss

6.4.1 Conditions for RETEST

The Part 572E test dummies and the test vehicle are instrumented in order to obtain data needed for the New Car Assessment Program (NCAP). The dummy data from the 35 mph frontal barrier impact tests, specifically from those channels providing Head Injury Criteria (HIC), Chest Acceleration (Gs), and left side/right side femur loads for evaluation against FMVSS No. 208 injury criteria, and the visual record of dummy kinematics are absolutely essential to NCAP. An invalid NCAP test is one which does not conform precisely to all requirements/specifications of the NCAP Laboratory Test Procedure and Statement of Work applicable to the test.

The contracting officer of NHTSA is the only NHTSA official authorized to notify the contractor that a retest is required.

No test report is required for any test which is determined to be invalid unless NHTSA specifically decides, to require the Contractor to submit such report. Invalidated test reports will not be publicly released.

RETEST CONDITIONS

Failure of the contractor to obtain the above data and to maintain acceptable limits of test parameters in the manner outlined in this test procedure shall require a retest at the expense of the contractor and will include the cost of the vehicle replacement and retest at the contractor's expense. The provisions of this paragraph apply to, but are not limited to, the contractor maintaining proper speed tolerance (35 ± .5 mph for the Full Frontal Barrier Test), vehicle seat cushion and back positioning, dummy positioning, correct lap and shoulder belt positioning, and test data acquisition, reduction, and processing.

The contractor shall also be responsible for obtaining usable data from all eight (8) primary channels from each of the two Part 572 test dummies placed in each vehicle front outboard designated seating position (DSP). Failure to produce such data shall also be at the expense of the contractor and shall include vehicle replacement and retest unless the Office of Market Incentives determines that the dummy data loss occurred through conditions beyond reasonable and foreseeable control of the contractor. Should it become necessary for the contractor to procure another test vehicle, it must have identical equipment and options as the original GPE vehicle. THE ORIGINAL GFE VEHICLE REMAINS THE PROPERTY OF NHTSA. THE RETESTED VEHICLE BECOMES THE PROPERTY OF THE CONTRACTOR. The retested vehicle shall be retained without fee by the testing facility until its disposal is authorized by the COTR.

6.4.2 Conditions for PARTIAL PAYMENT

The contractor shall exercise reasonable and foreseeable control to insure that no data is lost or rendered useless. If some non-critical data (such as camera failure, film breakage) and critical data (acceleration and load data) are not obtained for the crash test and the test is accepted by the Agency, the Agency will not pay for the missing or lost data.

6.5 Data Retention by Contractor

The contractor shall retain at no extra cost to the agency, reproducible copies of all data tapes (analog and digital), 16 mm movie films, and still photograph negatives.

6.6 Data Availability to the Public

The contractor shall provide interested parties with copies of test report, test CD's, test data tapes, test films, and test still photographs, at a reasonable cost to the purchaser, but only after, the Office of Crashworthiness Standards representative has advised the contractor that the results of that particular New Car Assessment Program test have been released to the public by the Agency.

6.7 Indicant Failure Notification

Any indication of a "test failure" to the requirements of FMVSS Nos. 208, 212,219 (Partial), or 301 shall be communicated by telephone to the Office of Crashworthiness Standards (202-366-1740) within 24 hours of the crash test.

NOTE: In the event of a failure, a post test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional cost.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

ACCEPTANCE OF TEST VEHICLES

The Contractor has the responsibility of accepting NHTSA provided test vehicles from either new car dealers or vehicle transporters. In both instances, the Contractor acts inthe NCAP's behalf when signing an acceptance of test vehicles. The Contractor must check to verify the following:

G. All options listed on the "window sticker" are present on the test vehicle.
H. Tires and wheel rims are the same as listed.
I. There, are no dents or other interior or exterior flaws.
J. The vehicle has been properly prepared and is in running condition.
K. The glove box contains an owner's manual, warranty document, consumer information, and extra set of keys.
L. Proper fuel filler cap is supplied on the test vehicle.
M. Verify that spare tire, jack, lug wrench, and tool kit (if applicable) islocated in the vehicle cargo area.

The Contractor shall check for damage which may have occurred during transit. The COTR is to be notified of any damage prior to preparation of the vehicle for testing.

NOTIFICATION OF COTR

The COTR must be notified within 24 hours after a vehicle has been delivered.

TEST DUMMIES

Part 572 Subpart E test dummies will be furnished to the contract laboratory by the NCAP. The dummies shall be stored in an upright seated position with the weight supported by the internal structure of the pelvis. The dummy's head shall be held upright without supporting the weight of the dummy by using an eye bolt that can be secured in the top of the head. These dummies shall be stored in a secured room which is kept between 55EF and 85EF. The Contractor will check the dummy components for damage when performing the calibration and complete a Dummy Damage Checklist that will be included in the final report, if requested. The COTR will be kept informed of the dummies condition in order that replacement parts can be provided.

Dummy Configuration and Performance Verification Testing

All GFE Part 572E test dummies, (normally four) shall be configuration and performance verification tested by the contractor ON-SITE using the test procedures found in **APPENDIX A** of this laboratory test procedure after each of the following occurrences:

a. Prior to the initiation of the crash test program.

NOTE: The post-test verification tests from a previous fiscal year's crash test program cannot be considered to be the pre-test verification for the following fiscal year's test program if a time period of more than one (1)month has elapsed or if the test dummies have been used for other tests.

b. In the event of a structural failure of one of the dummy's components(clavicle, rib, femur ball, etc.) during it's use in a vehicle crash test.

c. In the event that the dummy's acceleration-time traces obtained during a previous vehicle crash test usage show any unexplainable abnormalities. An OCS engineer should be notified immediately of all abnormalities and explanations that would indicate that a dummy verification test is not required under this final test report.

d. **After every three (3) vehicle crash test usages** in which no abnormalities or failures have occurred.

e. After each vehicle crash test usage in which one or more of the FMVSS No. 208 injury criteria maximum allowable limits were exceeded such as a HIC greater than 1000, chest Gs of more than 60 for a time interval greater than 3 milliseconds, or femur loads greater than 2250 pounds.

NHTSA will supply contract laboratories with the following equipment:

1. New test vehicles.

2. Part 572E test dummies.

3. In the case of the Full Frontal Barrier Test, a load cell barrier assembly which will include 36 load cells.

4. Instrumented Lower Legs

5. 6-Axis Neck Load Cells

NOTE: Contractor will furnish all dummy and vehicle instrumentation, and all data acquisition, reduction, and processing equipment except as indicated above.

DUMMY DAMAGE CHECKLIST - HYBRID III DUMMY
(To be included in test report with dummy calibrations, if requested)

Dummy Serial No. _____ Project No._____

OK	Damaged	
_____	_____	(Begin with general cleaning)
_____	_____	Outer skin on entire dummy (gashes, rips, etc.)
_____	_____	Head -Check that ballast is secure
_____	_____	Gashes, rips, general appearance,, etc.
_____	_____	Neck -Broken or cracks in rubber
_____	_____	Check that upper neck bracket is firmly attached to lower neck bracket
_____	_____	Check for looseness at the condyle joint
_____	_____	Nodding blocks -- cracked or out of position
_____	_____	Spine - Broken or cracks in rubber
_____	_____	Ribs - Check all ribs and rib supports for damage (bent or broken)
_____	_____	Check damping material or separation or cracks
_____	_____	Three rubber bumpers in place

Chest displacement assembly

_____	_____	Bent shaft
_____	_____	Slider arm riding correctly, in track

Transducer Leads -

_____	_____	Torn cables

Accelerometer Mountings (head, thorax, pelvis)

_____	_____	Check for secure mounting

Knees - Check outer skin, insert and casting (without removing insert)
Limbs - Check for normal movement and adjustment
Knee sliders -

_____	_____	Wires intact
_____	_____	Rubber returned to "at rest" position

_____	_____	Pelvis -Inspect for breakage, esp. at iliac crest
_____	_____	Other _____
		_____

If upon visual examination, damage is apparent in any of these areas, the appropriate engineer or engineering technician is to be consulted for a decision on repair or replacement of parts.

Repair or Replacement approved by:
_____
Signature Date
Comments on repair or replacement of parts:
_____

8. CALIBRATION AND INSTRUMENTATION

Before the Contractor initiates the NCAP test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices. Guidelines for setting up and maintaining such calibration systems are described in MIL-C-45662A, "Calibration System Requirements." The calibration system shall be set up and maintained as follows:

M. Standards for calibrating the measuring and test equipment will be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the Contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 6 months for instruments and 12 months for the calibration standards. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment. The calibration frequency can be increased if deemed necessary by NHTSA. Calibration procedures must conform to SAE Standard J211, Instrumentation for Impact Testing (Appendix I). The following is a recommended practice for accelerometer calibration (refer to J211):

1. FREQUENCY RESPONSE - The accelerometer sensitivity is monitored as the frequency is cycled from approximately 10 to 10000 HZ. The sensitivity should remain fixed.

2. LINEARITY - The accelerometer placed on a shaker table, is cycled from 5g to 100g at100HZ. There should be minimal sensitivity variation throughout the cycle as described in SAE J211. The sensitivity of the accelerometer should also be compared to previous calibration values, and to the manufacturer's initial submitted value. If a variation greater than approximately 2 to 5 % (not specified) is recorded, than the accelerometer should not be used. In addition, the zero offset of the unit should be compared to previous values.

3. TRANSIENT WIDE BAND FREQUENCY DROP TEST - For this test, the accelerometer alongside a known standard and utilizing a drop tower, is dropped from varying heights. The accelerometer output is compared to the standard. In this setup, both frequency response and the amplitude linearity can be checked. The amplitude frequency response should beat a minimum up to CLASS 1000 as defined by SAE J211. The amplitude response of the accelerometer from the different drop heights can be used to compute the amplitude linearity tolerance. The drop heights are arbitrary, but it is recommended that the accelerometer be dropped from at least one height which produces a g level that is greater than that expected in the actual test environment.

4. SENSOR HISTORY - A sensor calibration history should be maintained. During each calibration, prior values should be referenced. If wide disparities exist between values, then the sensor should not be used.

C. All measuring and test equipment and measuring standards will be labeled with the following information:

A. Date of calibration

B. Date of next scheduled calibration

C. Name of the technician who calibrated the equipment

D. A written calibration procedure shall be provided by the Contractor which includes as a minimum the following information for all measurement and test equipment:

(1) Type of equipment, manufacturer model number, etc.

(2) Measurement range

(3) Accuracy

(4) Calibration interval

(5) Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident)

(6) The actual procedures and forms used to perform the calibrations.

E. Records of calibration for all test instrumentation shall be kept by the Contractor in a manner which assures the maintenance of established calibration schedules. All such records shall be readily available for inspection when requested by the COTR and shall be included in the final test report as shown in **APPENDIX A**. The calibration system will need the acceptance of the COTR before NCAP testing commences.

F. Test equipment shall receive a pre and post test zero and calibration check. This check shall be recorded by the test technician(s) and submitted with the final report as described in section 11. 13.

G. Anthropomorphic test devices shall be calibrated according to the schedule indicated in part 7 above. The calibrations and calibration check shall be submitted with the final report.

H. The Contractor Furnished data acquisition and processing system for recording signals from ATD and vehicle sensors in vehicle test shall be qualified by performing the qualification test as specified in **APPENDIX F**, "Data Acquisition System Qualification Requirements and Test Procedure."

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COTR's discretion and will be performed without additional cost.

LOAD CELL BARRIER

Calibration

Load cells shall be calibrated on an "as needed" basis and on a semi-annual schedule. Need shall be established by pre and post test shunt calibration. If bridge balance remains unchanged (pre and post test) and if full scale shunt calibration results in the same factor, then the transducer characteristics are within calibration. If loads become suspect, linearity of the load cell shall be checked with a universal compression testing machine. If the load cell is non-linear or if pre and post test calibration results in a "drift" the load cell shall be returned to the manufacturer for check-out and calibration. Notify the OCR whenever calibration problems arise.

Maintenance

Load cells are prone to corrosion when exposed to damp environments. Therefore, extra precautions shall be taken to prevent moisture entering the cells. **CAUTION:** Weep holes are provided for equalization of barometric pressure and must be directed downward. If cells are found with the hole pointing upward, the cell must be removed and calibrated by compression testing and if non-linear, returned to the manufacturer. The load cell barrier shall be covered between tests. When the load cell barrier will not be used for a period of time, it shall be removed from the barrier area and placed in a dry storage area. The plywood blocks shall be intact and completely bonded to the backup support. If these blocks receive significant damage during crash testing, they shall be replaced/repaired such that a full surface is present.

Recorders and Equipment

Normal practice shall be employed with recorders and equipment calibrations for load cells. When load cells are calibrated, a system calibration procedure shall be employed where the load cell is calibrated in the system used for amplifying/recording the load cell output signal. Alternately, the system maybe calibrated separately, but this is not the desired method.

9. PHOTOGRAPHIC DOCUMENTATION

Each NCAP test shall be documented on 16 millimeter (mm) color movie film at a speed as close to **1000** frames-per-second (fps) as possible, except for the 24 fps real-time cameras. Glare or lights showing on any glass area (closed windows or vents) must be minimized so that views of the dummies during the test are visible for film analysis.

A timing mark (usually LED) must be registered on the film edge a minimum of every 10 milliseconds (ms) and a time zero impact mark (usually LED) must-be registered on the film to indicate when contact with the barrier is made in order to permit vehicle and dummy kinematic analysis on a film analyzer. It is preferable that the timing and impact marks be located on separate side of the film frame. The Contractor shall report all camera locations along with camera speeds and lens focal lengths on the appropriate final report data sheets. Camera locations will be referenced to the barrier face and monorail centerline with the X, Y, and Z coordinates of the film surface recorded for each camera (FIGURE 4).

The vehicle interior may require auxiliary on-board lighting to ensure adequate film exposure.

9.1 CAMERAS REQUIRED

CAMERA 1
Real-time (24 fps) left side view camera to follow the test vehicle down the tow road, across the photographic pit, and into the barrier face.

CAMERA 2
High-speed left side view camera to cover the vehicle's left side from the barrier face to a point rearward of the vehicle's front seat backs. The centerline of the camera shall be perpendicular to the longitudinal centerline of the vehicle.

CAMERA 3
High-speed left side view camera positioned adjacent to the vehicle's A-post to document the driver dummy's head movement during the impact event in the windshield area and windshield zone intrusion area. The centerline of the camera shall be perpendicular to the longitudinal centerline of the vehicle.

CAMERA 4
High-speed left side view camera positioned adjacent to the vehicle's B-post or center post to document the movement of the driver dummy during the impact event.

CAMERA 5
High-speed left side view camera positioned adjacent to the vehicle's B-post to document the movement of the vehicle's steering column/wheel assembly relative to the roof targets and the rear

sill target during the impact event. (This camera is also used for steering column displacement analysis.) The centerline of the camera shall be perpendicular to the longitudinal centerline of the vehicle.

CAMERA 6

High-speed left side view camera positioned adjacent to the vehicle's left front door and underneath CAMERA 5 to document the movement of the vehicle's steering column/wheel assembly relative to the roof target and the rear sill targets during the impact event. (This camera is also used for steering column displacement analysis.) The centerline of the camera shall be perpendicular to the longitudinal centerline of the vehicle.

CAMERA 7

High-speed right side view camera to cover the entire right side of the test vehicle during the impact event. The centerline of the camera shall be perpendicular to the longitudinal centerline of the vehicle.

CAMERA 8

High-speed right side view camera positioned adjacent to the vehicle's A-post to document the passenger dummy's head movement in the windshield area during the impact event and windshield zone intrusion. The centerline of the camera shall be perpendicular to the longitudinal centerline of the vehicle.

CAMERA 9

High-speed right side view camera positioned adjacent to the vehicle’s B-post (or center) to document the movement of the passenger dummy during the impact event.

CAMERA 10

High-speed right side view camera positioned adjacent to the vehicle's right front door to document the movement of the passenger dummy during the impact event.

CAMERA 11

High-speed overhead camera positioned directly above the vehicle's windshield centerline to cover the windshield area during the entire crash event. A polarizing filter may be used to eliminate windshield glare.

CAMERA 12

High-speed front view camera mounted above the barrier face to document the movement of the driver dummy during the impact event and windshield zone intrusion.

CAMERA 13

High-speed front view camera mounted above the barrier face to document the movement of the passenger dummy during the impact event and windshield zone intrusion.

CAMERA 14
High-speed photographic pit camera positioned beneath the vehicle's engine compartment to record the vehicle structural crush and document any Stoddard solvent spillage.

CAMERA 15
High-speed photographic pit camera positioned beneath the vehicle's fuel tank to document any Stoddard solvent spillage.

CAMERA 16
High-speed left side on-board camera positioned on the vehicle's rear floorpan to document the movement of the driver's belt system webbing at the retractor unit during the impact event.

CAMERA 17
High-speed right side on board camera positioned on the vehicle's rear floorpan to document the movement of the passenger's belt system webbing at the retractor unit during, the impact event.

Note: The outside rearview mirror's may be removed to eliminate any camera view obstructions.

9.2 COLORING REQUIREMENTS FOR PHOTOGRAPHIC PURPOSES

A. Vehicle interior surfaces such as the instrument panel, A-post trim panels, door trim panels, console, etc., shall be painted with flat white paint. The air bag indicator light on the dash shall **NOT** be painted so as to be visible prior to testing.

B. Vehicle underbody components such as the floor pan, frame rail members, steering mechanism, suspension components, engine oil pan, and all fuel system components shall be painted with different colored paint (pink, green, blue, orange, etc.).

C. Parts of the driver and passenger dummies shall be coated with colored chalk/water solutions to show contact points with the vehicle's interior, with their own components (such as head to knee contact), and with each other. The chalk/water solution shall be applied after final dummy positioning.

CHALK COLORS TO BE USED ON TEST DUMMIES

DUMMY PART	DRIVER	PASSENGER
Nose	Red	Yellow
Lips	Red	Yellow
Face	Blue	Red
Top of Head	Yellow	Blue
Back of Head	Red	Yellow
Left Knee	Red	Yellow
Right Knee	Blue	Blue (FMVSS 208 uses Red)
Lower Steering Wheel Rim	Red	

NOTE: Face chalk should extend below the chin.

NOTE: Passenger dummy only required in Full Frontal Barrier Test.

D. The driver dummy and passenger dummy clothes shall be contrasting colors so that the motion of each dummy can be identified during film analysis.

E. Tires and wheels should be painted with two white perpendicular lines to reveal tire motion.

9.3 PHOTOGRAPHIC COVERAGE OF FUEL FILLER CAP INSTALLATION

The removal, installation and tightening of the vehicle's fuel filler cap and the cap's rotation to its locked position by Contractor's personnel will be documented. This 16 mm color movie film

footage shall appear in the final released movie print to show that the filler cap was properly installed and tightened prior to the crash test.

9.4 PHOTOGRAPHIC COVERAGE OF STODDARD SOLVENT SPILLAGE

The real-time camera (24 fps) shall be used to record any Stoddard solvent spillage from the test vehicle after the impact event or during the static rollover test.

9.5 VEHICLE AND DUMMY PHOTOGRAPHIC COVERAGE

The real-time camera (24 fps) shall be used to document the pretest and post test condition of the test vehicle in addition to the pretest and post test positions of both test dummies (including marks showing the fore and aft seat position) and placement of the lap and shoulder belts on these dummies. The positions of the belt load cells shall be documented along with the tape supports for the shoulder belt load cells.

9.6 IMPACT EVENT MARKER

Strobe lights or taped photo-flash bulbs (cloth tape on bulb exterior to form small slit for light passage) will be placed in the field-of-view of all cameras to mark "time zero" for the vehicle to-barrier impact event. The Contractor shall use barrier face or vehicle mounted pressure switches which will be contacted by the forward most component of the test vehicle, such as bumper guards, in order to trigger the 'time zero" indicators. Light from the impact detectors **SHOULD NOT COVER MORE THAN 3 FRAMES OF HIGH-SPEED FILM.** Suggested locations for impact detectors or "time zero" markers areas follows:

A. Vehicle's roof panel along longitudinal centerline above windshield header.

B. Top surface of vehicle's instrument panel along longitudinal centerline

C. Adjacent to engine oil pan.

D. Adjacent to vehicle's fuel tank.

9.7 REFERENCE TARGETS

9.7.1 Reference photographic targets shall be rigidly mounted on the test vehicle and attached to the barrier assembly as shown in Figures 4 and 5. The primary moving reference targets Al and A2 **MUST BE** mounted 24 inches (609.6 mm) apart on a flat rectangular panel, and be firmly fixed to a structure of the vehicle that remains undisturbed by the crash, such as the vehicle roof. The panel must be in the same plane as the plane of motion (Figure 6). The setup rotation of the panel within the motion plane is unimportant. To insure against unexpected displacements of the car top, the backup moving reference targets Cl and C2 should also be attached to undisturbed portions of the vehicle, such as the vehicle door or body, and must also be 24 inches (609.6 mm) apart.

One 1 inch wide checkerboard tape should be applied down center of vehicle, including top of hood, roof, and deck lid. Also apply tape down both sides of vehicle approximately 4 inches above wheel opening.

Photographic targets should be placed at one foot intervals along the side of the vehicle along the 1 inch tape. Target placement should be documented.

Stadia poles or similar fixed ground reference targets are to be positioned vertically from the roadway surface on the driver and passenger sides of the vehicle (in the camera view, and at about door midpoint), to assist in high speed film evaluation of the event.

9.7.2 The dummies shall have targets on each side of the head with the center of the target as close as possible to the center of gravity of the head in the x and z direction (relative to the measuring directions of the accelerometers). Targets shall be placed on the outboard shoulder of each dummy. Cut away a section of the sleeve (do not remove the sleeve) of the dummy and place the target as high up on the arm as possible at the intersection of the arm and the shoulder.

9.7.3 The top portion of the steering wheel shall have tape with 1 inch squares(the squares having alternating colors like black and yellow) placed on it.

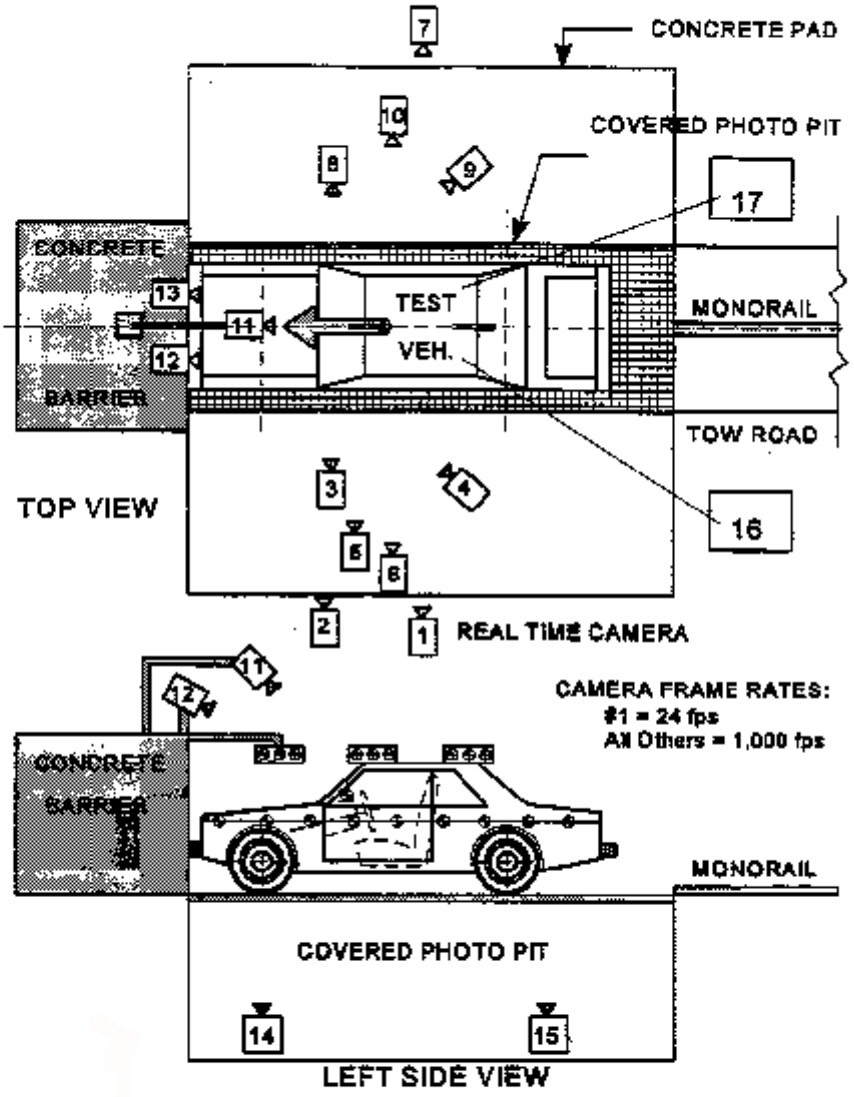


Figure 4 CAMERA POSITIONS FOR FULL FRONTAL BARRIER TESTS

9.8 INFORMATIONAL PLACARDS

Vehicle identification placards shall be positioned so that at least 1 placard will be visible in the field-of-view for each of the cameras. The following information will be shown:

A. Vehicle's NHTSA Number

B. The words "NCAP 35 MPH FULL FRONTAL"

C. Date of crash test

D. Name of contract laboratory

E. Vehicle year, make and model

9.9 CRASH FILM TITLE AND ENDING

The 16 mm crash test movie film shall include the following title frames:

A. "The following (35 mph frontal barrier impact test) was conducted under contract with the National Highway Traffic Safety Administration by (name and location of test laboratory)"

B. 35 MPH FRONTAL BARRIER IMPACT TEST

TEST VEHICLE[8]
MODEL YEAR, MAKE AND MODEL

NHTSA No. CXXXXX

DATE OF IMPACT EVENT

CONTRACT NO.: DTNH22-9X-X-XXXXX

C. The ending frame shall state "THE END"

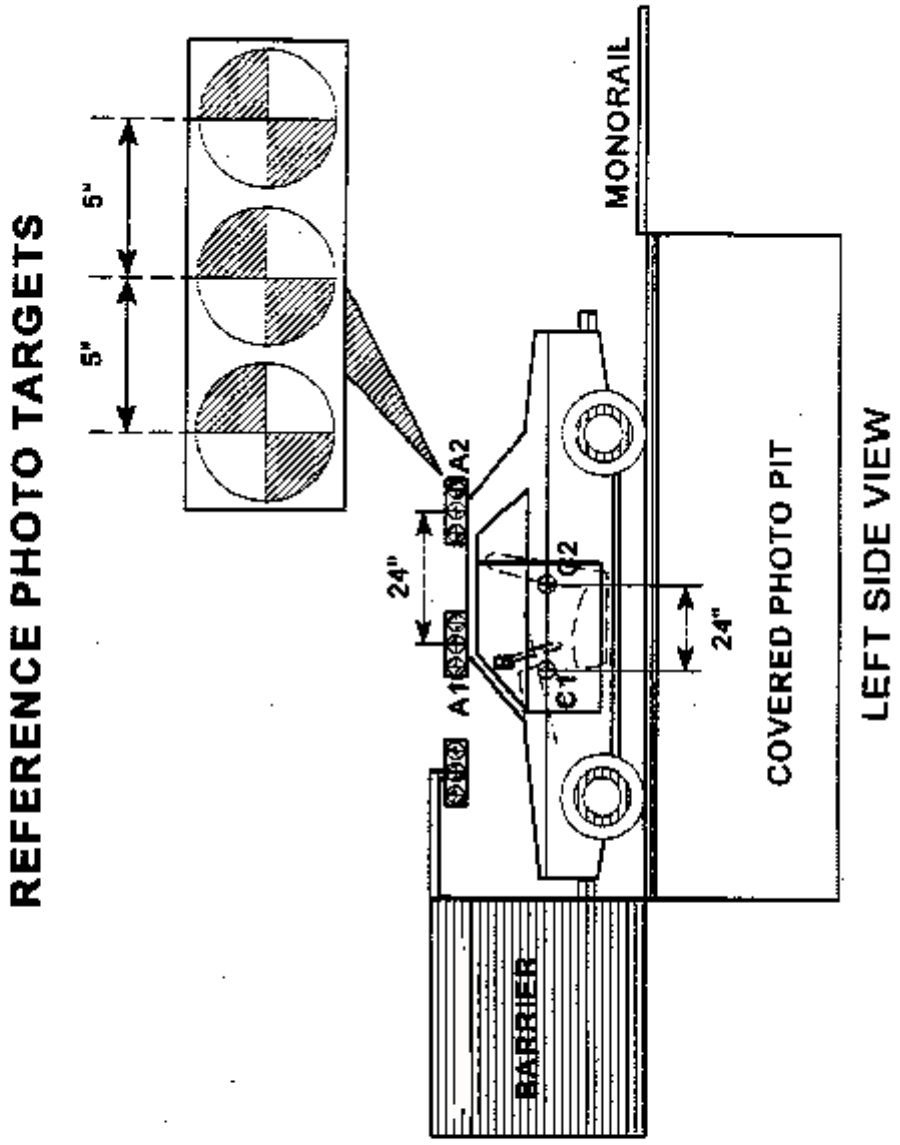

REFERENCE PHOTO TARGETS
5"
5"
MONORAIL
A2
24"
A1
e2
e1
24"
COVERED PHOTO PIT
BARRIER
LEFT SIDE VIEW

FIGURE 5

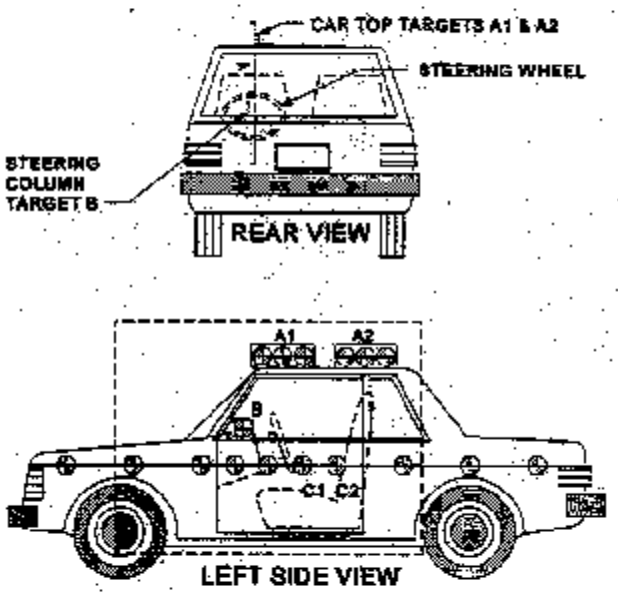

CAR TOP TARGETS A1 & A2
STEERING WHEEL
STEERING COLUMN TARGET B
REAR VIEW
A1
A2
B
C1
C2
LEFT SIDE VIEW

FIGURE 6

9.10 FILM EDITING

The film shall be edited in the following sequence:

A. Title

B. Pretest Coverage

C. Real Time Pan Coverage

D. All high speed coverage in numerical order as shown in figure 4.

E. Post test Coverage

F. Rotating Fixture Coverage (a minimum 10 seconds "burst" during 0 to 90 degree roll)

G. 'The End'

All fuel system, windshield, seat back, or any vehicle failures shall be completely documented.

9.11 STILL PHOTOGRAPHS

Provide still photographs (8 x10 or $8^1/_2$ x 11 inch color prints properly focused for clear images) of pretest and post test condition of entire vehicle deformation and details which pertain to the tested standards. Photographs of all areas of the test vehicle that may be of importance to the frontal barrier impact test should be taken in excess and developed only if the need arises.

The following still photographs are required for the NCAP test:

A) Pretest and post test frontal view of test vehicle

B) Pretest and post test left side view of test vehicle

C. Pretest and post test right side view of test vehicle

D. Pretest and post test right front three-quarter view of test vehicle

E. Pretest and post test left rear three-quarter view of test vehicle

F. Pretest and post test windshield view

G. Pretest and post test engine compartment view

H. Pretest and post test fuel filler cap view

I. Pretest and post test front underbody view[1]

J. Pretest and post test rear underbody view[1]

K. Pretest and post test driver dummy position with the camera perpendicular to the longitudinal centerline of the vehicle and in line with the markings showing the fore-aft position of the seat.

L. Frontal pretest and post test driver dummy position with the camera in the same plane as the longitudinal centerline of the dummy.

M. Pretest and post test passenger dummy position with the camera perpendicular to the longitudinal centerline of the vehicle Nd in line with the markings showing the fore-aft position of the seat.

N. Frontal pretest and post test passenger dummy position view with the camera in the same plane as the longitudinal centerline of the dummy.

O. Pretest and post test driver dummy and vehicle interior view with the door open.

P. Pretest and post test passenger dummy and vehicle interior view with the door open.

Q. Dummy contact point(s) vehicle and dummy

R. Pretest and post test view of the knee bolsters.

* S. Pretest and post test view of the steering column shear capsule if any part of it is visible. Do NOT disassemble any parts to take these photographs.

* T. Pretest and post test view of the under hood steering shaft and steering box. Take the best photograph possible without removing any parts.

* U. Pretest and post test view of the steering column intersecting the fire wall from the inside of the vehicle. Take the best photograph possible without removing any parts.

* V. Pretest and post test under hood view of the steering column intersecting the firewall. take the best photograph possible without removing any parts.

W. Photograph of ballast installed in vehicle.

X. Post test Stoddard solvent spillage location view, if required.

Y. Post test top view of test vehicle while vehicle is on static rollover machine.

Z. Photograph of certification label.

* Photographs not required in final report.

(1) NOTE:
The underbody views will include the following vehicle components: fuel pump, fuel lines, sender unit, fuel tank filler pipe and any other visible fuel system components.

Still photographs - 8 by 10-inch color prints

Two (2) copies of a color 8 by 10-inch side view photograph of the test vehicle at the moment of barrier impact shall be furnished to the Office of Crashworthiness Standards with the final report.

10. DEFINITIONS

None

11. PRETEST AND FACILITY REQUIREMENTS

11.1 DETAILED TEST AND QUALITY CONTROL PROCEDURES REQUIRED

Prior to conducting any NCAP test, Contractors are required to submit a detailed in-house NCAP test procedure to the COTR which includes:

A. A step-by-step description of the methodology to be used.

B. A written Quality Control (QC) Procedure which shall include calibrations, the data review process, report review, and the people assigned to perform QC on each task.

C. A complete listing of test equipment which shall include instrument accuracy and calibration dates.

M. Detailed checkoff lists to be used during the test and during data review. These lists shall include all test procedure requirements. Each separate checkoff sheet shall identify the lab, test date, vehicle and test technicians. These check sheets shall be used to document that

all requirements and procedures have been complied with for each test. The check sheets should be kept on file.

There shall be no contradiction between the NCAP Laboratory Test Procedure and the Contractor's in-house test procedure. The procedures shall cover all aspects of testing from vehicle receipt to submission of the final report. Written approval of the procedures must be obtained from the COTR before initiating the NCAP test program so that all parties are in agreement.

11.2 INSTRUMENTATION REQUIRED

11.2.1 TEST DUMMIES

The Contractor shall provide and install the following instrumentation in the GFP dummies.
Typical instrument locations are shown in Figures 1 and 2.

A. Three accelerometers shall be in the head cavity to measure orthogonal accelerations (Ax, Ay and Az) at the center-of-gravity (CG) of the head assembly. The 3 accelerometers shall be mounted in an orthogonal array, and the intersection of the planes containing the sensitive axis of the 3 sensors will be the origin of the array. Detailed information concerning the locations for the sensors can be found in Appendix A. (Part 572 Subpart E dummies may be required by COTR to have Endevco 7231 C-750 accelerometers with 1 % transverse sensitivity or Endevco 7264's.)

B. Three accelerometers shall be installed in the chest cavity to measure orthogonal accelerations (Ax, Ay and Az) at the C.G. of the chest assembly. Location information can be found in Appendix A. (Part 572 Subpart E dummies may be required by COTR to have Endevco 7231 C-750 accelerometers with 1% transverse sensitivity or Endevco 7264's.)

C. Two load cells shall be required for each dummy and shall be installed in each upper leg to measure the axial force transmitted from the dummy's knee to the upper leg or femur. Mounting instructions can be found in Appendix A. (Part572E dummies may be required by COTR to have GSE Inc. Model 2430 load cells (Dwg. 78051-265))

D. Chest compression (deflection) shall be measured using standardized 572E equipment as described, in **Appendix A**.

E. The upper neck will be instrumented with a NHTSA provided six axis neck load cell to measure Fx, Fy, Fz, Mx, My, Mz as described in **Appendix A**.

F. Three accelerometers shall be mounted in the pelvic cavity to measure orthogonal accelerations (Ax, Ay, and Az). The contractor will be provided a modified 572E pelvic

mount (78051-54) and an Endevco triaxial mounting block for use with Endevco 7264 accelerometers.

G. Lower legs (NHTSA provided), instrumented to measure upper tibia moment x and y, lower tibia force z, and lower tibia moment x and y, will be used when provided by the Government.

H. Head and chest shall be additionally instrumented with redundant accelerometers (Endevco 7264's) according to the guidelines in **Appendix C.**

I. Feet should be instrumented with accelerometers to measure acceleration in the X, Y, and Z axis as described in **Appendix D.**

J. Temperature sensors to measure the stabilized temperature of the dummy (see Section 12.7).

Once the contractor has installed instrumentation in a particular dummy and conducted a configuration and performance verification test, these units of instrumentation shall remain installed in that dummy for the duration of the crash test program unless there is an equipment failure or calibration is necessary.

11.2.2 TEST VEHICLE INSTRUMENTATION

Vehicle accelerations are to be recorded, and the Contractor shall provide and install the following accelerometers:

A) Full Frontal Barrier Test

X-DIRECTION ACCELEROMETERS:

#1. Rear seat cross-member on left side of vehicle

#2. Rear seat cross-member on right side of vehicle

#3. Top of engine block

#4. Bottom of engine

#5. Right front disc brake caliper

#6. Left front disc brake caliper

#7. Center of instrument panel top surface

#8. Redundant rear seat cross-member - left

#9. Redundant rear seat cross-member - right

The location of the accelerometers as well as the acceleration versus time output shall be recorded and included in the final test report and tape/diskette.

11.2.3 LAP AND SHOULDER BELT LOAD CELLS

(ATTACHMENT OF LOAD CELLS SHALL NOT AFFECT THE POSITIONING OR RESPONSE OF THE BELTS)

Load cells, such as the Lebow Model 3419, shall be mounted on the front outboard lap and shoulder belts (4 load cell units required).

Lap belt units: The lap belt load cells shall be positioned on the belt webbing so as to avoid contact with any objects other than the lap belt to which they are attached.

Shoulder belt units: The shoulder belt load cells shall be mounted immediately behind the dummy's outboard shoulder such that during the frontal crash test they do not come in contact with anything other than the belt to which they are attached. Each load cell shall be suspended by a support such as masking tape so that the weight of the load cell does not introduce any slack into the belt system as the test vehicle travels down the tow road. The tape should be strong enough to carry the load cell's weight, but not strong enough to affect belt stretch or loading. Normally, if one-inch wide tape is used, a tear across the tape approximately 3/4-inch long at the center suspension point between the load cell and the vehicle's inner roof rail will be sufficient to insure that an immediate break-away condition will exist at the moment of barrier impact.

1 1.2.4 SEAT BELT PERFORMANCE ASSESSMENT

The contractor shall measure the belt system spool-out, retractor lock-up time, belt webbing stretch, and belt lengths.

Webbing Spool-out: This will be assessed at the retractor unit by using a high-speed camera for the left and right sides (2 cameras required).
NOTE: The contractor shall **NOT REMOVE ANY TEST VEHICLE SEAT BELT RESTRAINT SYSTEM ANCHORAGES** which includes 'D' ring, retractor housing, buckle and cable, etc., attachments to the vehicle body.

Webbing spool-out shall be determined as follows:

1. **DO NOT REMOVE INTERIOR TRIM MOLDINGS FROM VEHICLE** in order to

expose the belt system's retractor unit. **DO NOT CUT SHEET METAL STRUCTURAL SUPPORTS OR PANELS** in order to gain access.

2. Mark white lines approximately 1/4-inch wide and spaced 1 -inch apart on the belt webbing starting at the retractor reel and extending for 5 inches of webbing outside of the reel. This marking process takes place **AFTER THE RESTRAINT SYSTEM HAS BEEN FITTED AROUND THE DUMMY**. Typewriter correction fluid has been successfully used in the past for marking the belt webbing.

The line adjacent to the retractor, or the line closest to the D-ring, whichever is in on-board camera of view, should be delineated by a dashed vs. solid line

3. High-speed cameras (2) #16 and #17 shall be focused on the marked portion of the belt webbing and the two front outboard retractor units in order to record webbing spool-out using the white lines as reference points.

4. "Time zero" for the impact event shall be indicated by a strobe light or taped flash bulb within the field-of-view of both cameras in order to assess the time delay for retractor lock-up after impact.

5. A linear potentiometer, such as the Bournes Model No. 5194 with an 8" range, shall be attached to the seat belt webbing for spool-out measurement. As a redundant backup measurement system, a 2-inch cube of Styrofoam shall be attached to the vehicle's 'B' post trim molding or at the base of the vehicle's 'B' post as shown in **Figure 7**. Thread shall be used with the foam to determine webbing spool-out. Tape can be used to retain the thread if unable to use the foam cube.
Webbing Stretch: Shoulder belt webbing elongation shall be determined by the use of a linear position transducer such as the following Bournes' Models(Bournes, Riverside, CA, 714-781-5182): Model No. 5141 with a 3/16" to 7/16"range.

Belt stretch shall be measured as close as possible to the shoulder belt load cell (between load cell and 'D' ring) and **NOT** between the retractor reel and the 'D' ring. For each front outboard DSP and prior to the crash test (seats and dummies in "final position'), the contractor shall record the length of seat belt webbing. Using the transducer data, the **PERCENT WEBBING ELONGATION** at maximum belt load shall be calculated and recorded. The appropriate maximum belt load shall be reported with this data even if it is reported elsewhere in the final test report. For redundancy, two 2 inch sections of shoulder belt webbing located along the dummy's chest area shall be fitted with thread configuration as shown in **Figure 8** during the pre-test operations. The amount of webbing stretch (thread movement) shall be measured after the frontal crash event, and the frontal crash event, and the percent webbing elongation shall be calculated using the thread measurement data.

Belt Length and Documentation
Measurement of lap and shoulder belt is to be performed and included in the final test report.

Shoulder Belts Data Recording

The location of the shoulder belt on the upper torso of each dummy by measuring the distance from the top surface of an aluminum plate placed across the top most surfaces of the dummy's upper legs upward to the top and bottom edges of the shoulder belt at the dummy's midsagittal plane shall be performed.

Detailed description of occupant restraint system characteristics including number of refractors, retractor locations), pre-tensioning devices, continuous system, adjustable D-Rings, motorized, 2 point, 3 point, etc. is to be provided in the test report.

11.2.5 BARRIER LOAD CELL REQUIREMENTS

A full face GFE load cell barrier will be mounted onto the face of the contractor's fixed barrier assembly. The total barrier load will be summed from the load cells and plotted as load versus the test vehicle dynamic crush. In addition, load versus time traces shall be supplied for each individual load cell, for the six groupings of load cells, and the total load as shown in the sketch in **Figure 9**.

A 18 x 83-inch extension has been added to the top of the load cell barrier to prevent hood override. The ridge steel frame shall be faced with 3/4-inch thick plywood.

All questions regarding the load cell barrier assembly, maintenance and calibration shall be directed to:

Safety Performance Standards
Office of Crashworthiness Standards (NPS-10)
Washington, D.C. 20590
(202) 366-6012

Method to Measure Shoulder Belt Webbing Spool-out

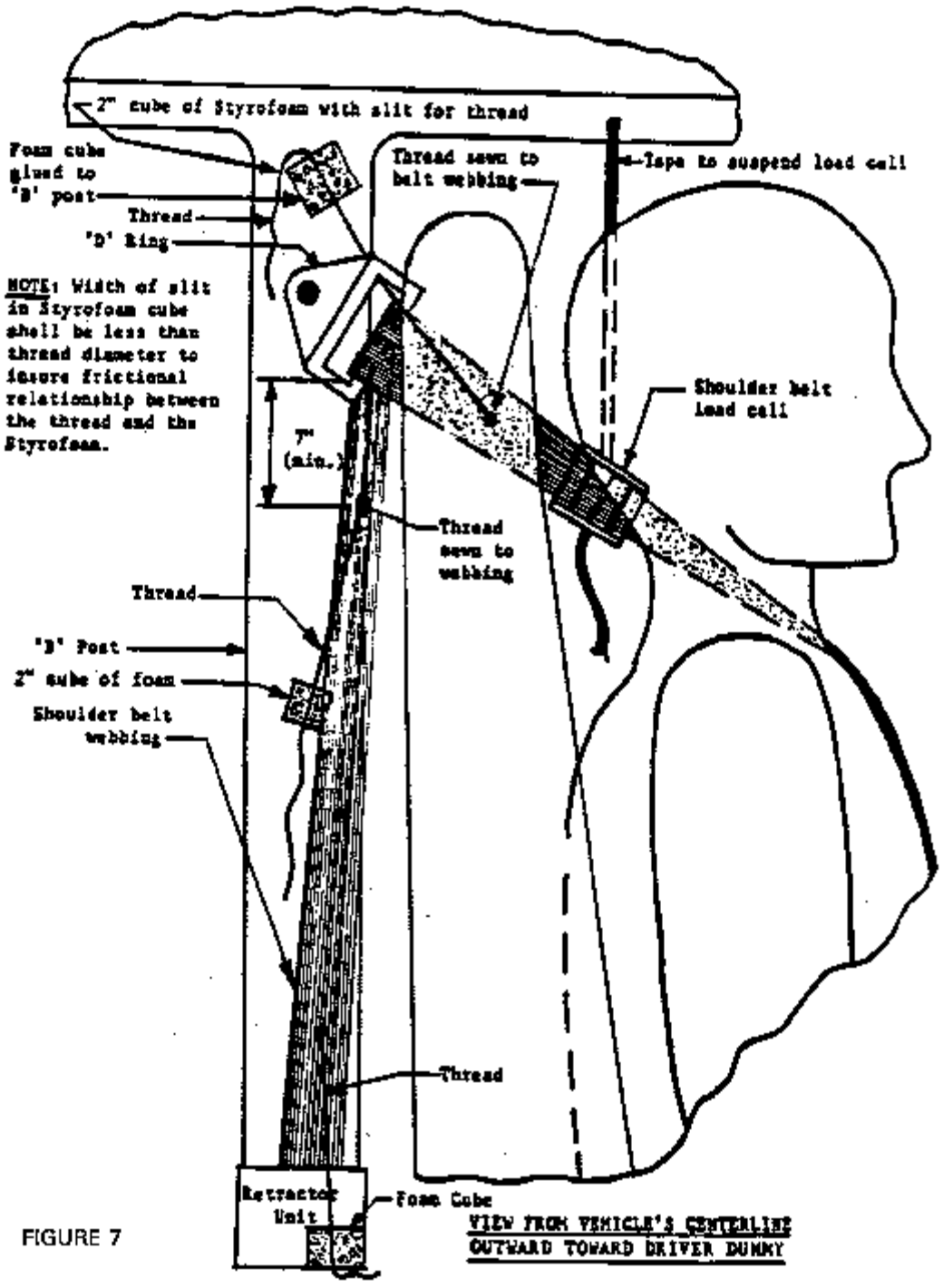
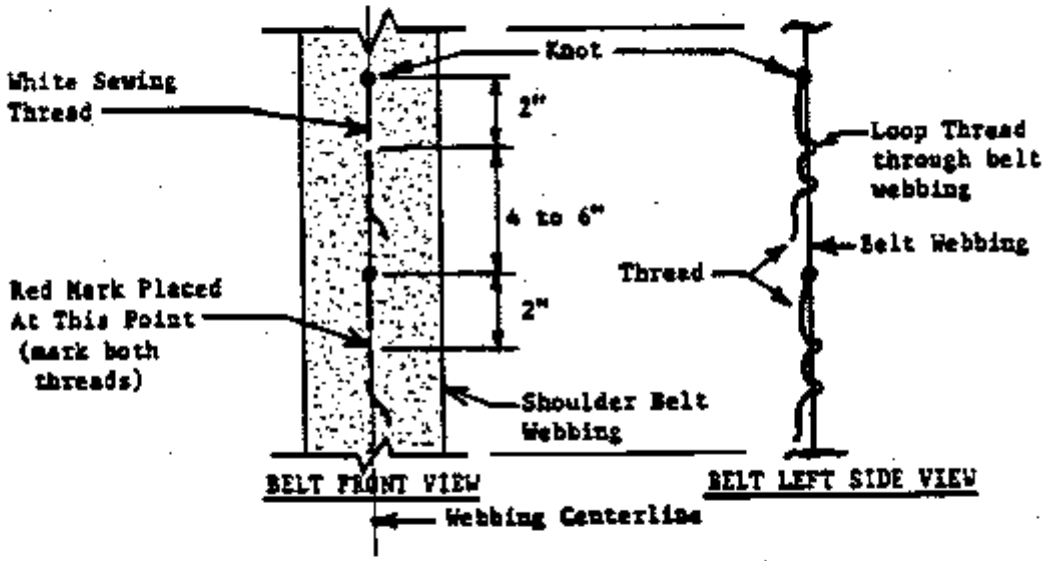


FIGURE 7



Method to Determine Belt Webbing Stretch

FIGURE 8

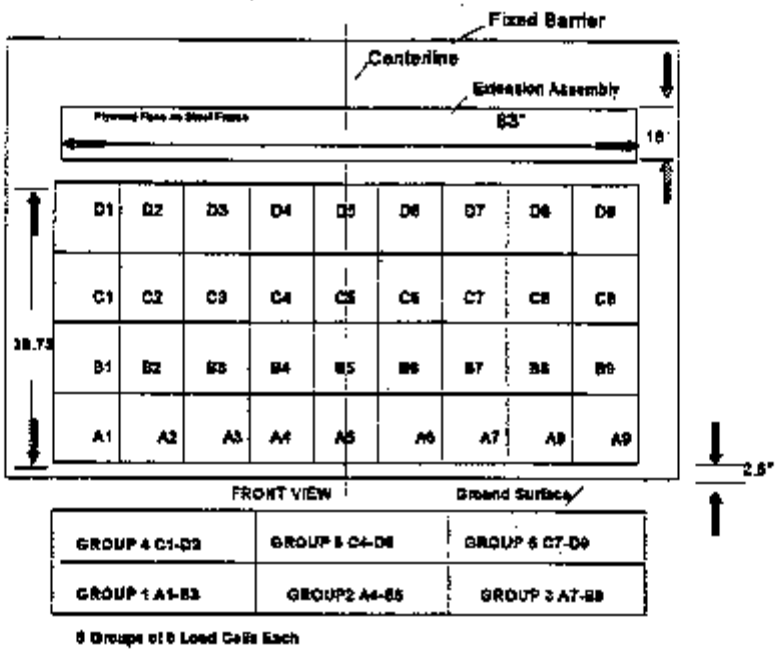


FIGURE 9

LOAD CELL LOCATIONS ON FIXED BARRIER

DATA REQUIREMENTS

(1) Data from 36 individual load cells
(2) Total or Sum of 36 individual load cells
(3) Data from 6 Groupings shown above (6 cells/group)
(4) Sum of 36 individual load cells vs. vehicle dynamic crush

11.3 DATA CHANNEL OUTPUT

The Contractor shall furnish data recording equipment having a sufficient number of channels available for recording the necessary time histories for the following:

1 . Head accelerations - 3 channels per dummy
2. Head redundant accelerations - 3 channels per dummy
3. Neck forces and moments - 6 channels per dummy
4. Chest accelerations - 3 channels per dummy
5. Chest redundant accelerations - 3 channels per dummy
6. Chest compression - I channel per dummy
7. Pelvic accelerations - 3 channels per dummy
8. Femur load cells - 2 channels per dummy
9. Lower leg instrumentation - 10 channels per dummy
10. Foot instrumentation - 6 channels per dummy
11. Seat belt load cells - 2 channels per dummy
12. Seat belt spoolout pots - 1 channel per dummy
13. Seat belt elongation pots - 1 channel per dummy
14. Vehicle accelerations - 9 channels
15. Load cell barrier - 36 channels

A total of **133** data channels for the Full Frontal Barrier Test when using 572E dummies is required plus minimum 1 time reference channel. Each data channel will be comprised of a sensor (accelerometer or load cell), signal conditioner, data acquisition device, and all interconnecting cables, and must conform to the requirements of **SAE** Recommended Practice J211, for Part 572E dummies with-data classes as follows:

A Head Acceleration Data/Neck Force/Pelvic/Foot Accel ..... Class l000

B. Chest Acceleration/Chest Compression Data ..... Class 180

C. Femur Force /Neck Moment/Tibia Forces/Tibia Moments ..... Class 600

D. Vehicle/Load Cell Barrier/Belt Loading and Displacement ..... Class 60

An instrument calibration system capable of performing individual tests on all data channels used in acquiring the acceleration, force, and displacement data shall conform to the appropriate section of SAE J211. A schematic of the test setup is shown in **FIGURE 8.**

A precision time system compatible with the test equipment shall be used to provide a time reference for all recorded data. A system that identifies the precise instant of barrier contact will be incorporated with the time reference signal. An instrumentation self-checking system that simultaneously monitors all data channels and displays, on a single indicator, will provide the status for the GO/NO-GO status of the sensor system.

11.4 COLLISION BARRIER

The basic fixed collision barrier must conform to the definition in Part 571.3--Definitions, 49 CFR Part 571.3, and at a minimum should consist of a reinforced concrete structure, 6 feet high, 6 feet thick, and 12 feet wide, weighing approximately 100,000 pounds. The Government furnished equipment (GFE) **load cell or** barrier shall be firmly attached to the reinforced concrete structure.

11.5 VEHICLE PREPARATION BUILDING

In order that the test vehicle can be prepared for crash testing at the head of the tow road during hot or cold weather, the Contractor shall have a temperature controlled building constructed which is large enough to house the test vehicle and allow for government, vehicle manufacturer, and laboratory personnel to move around the test vehicle. The building climate control must be capable of maintaining the ambient air temperature between 69EF and 72EF.

11.6 IMPACT SITE TOW ROAD

The tow road should be at least 500 feet in length and terminate at the face of the non-energy absorbing barrier as shown in **FIGURE 10**. The first 100 feet (approximate) from the head of the tow road will be used to accelerate the test vehicle up to the specified velocity without exceeding 0.5g which would effect the positioning of the P572 test dummies in the test vehicle. The second 100 feet (approximate) of tow road shall be used for dummy stabilization since the test vehicle should have approached the desired impact velocity with the acceleration now approaching zero. The remaining 300 feet (approximate) of tow road will be used for test vehicle speed stabilization.

The width of the tow road should be approximately 8 to 14 feet and should be straight and level so that the test vehicle does not oscillate vertically in excess of 0.29 g's.

A photographic pit will be located in the tow road at the stationary barrier face so that structural crush and possible fluid leakage of Stoddard solvent can be photographed during the impact event. The pit shall be covered using the following guidelines:

A. Use a material that allows for use of pit cameras (steel grating is an acceptable cover material).

B. The covering and its supports should simulate road strength in case the vehicle structure should come in contact with it during the NCAP test.

C. The entire pit should be covered except for the area needed for the tow system to operate.

D. Precautions must be taken to ensure there is no electromagnetic interference generated by the pit cover material.

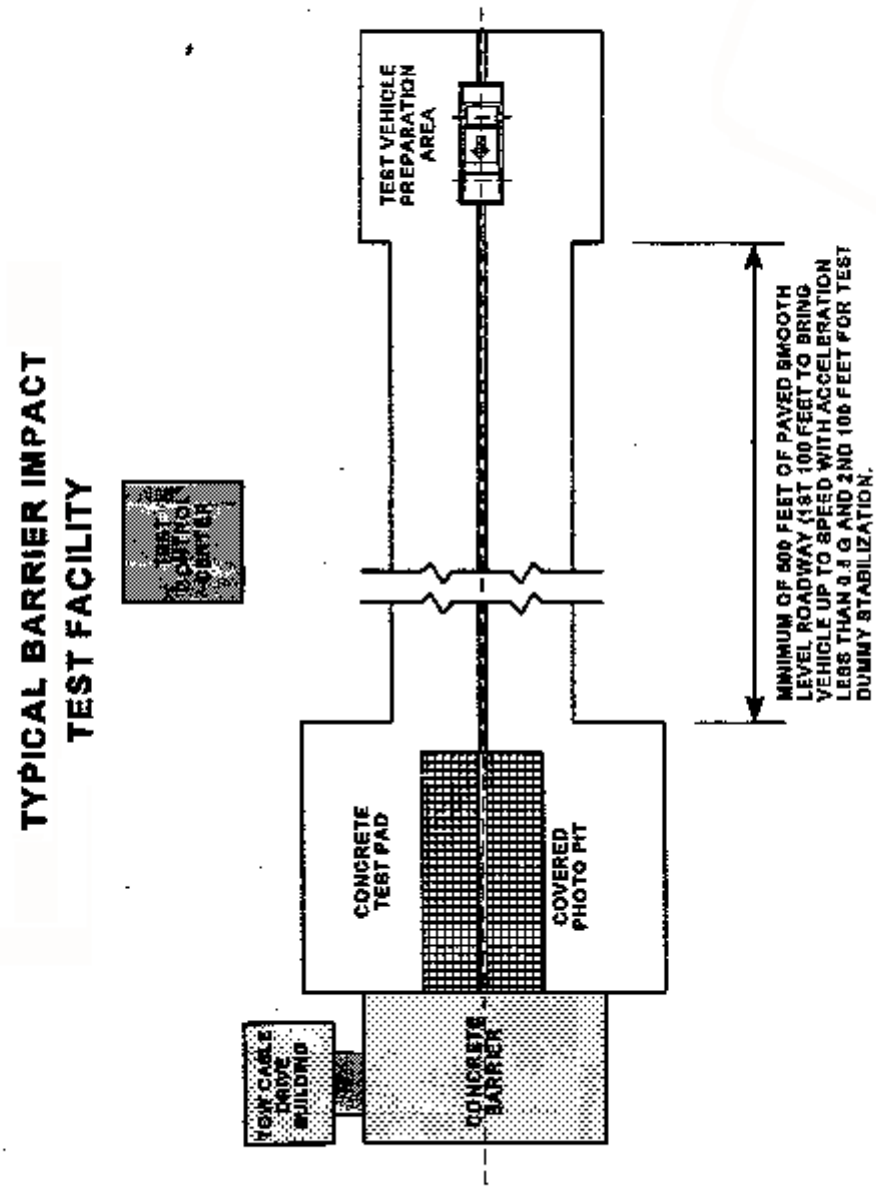

TYPICAL BARRIER IMPACT
TEST FACILITY
TEST VEHICLE
PREPARATION
AREA
CONCRETE
TEST PAD
COVERED
PHOTO PIT
CONCRETE
BARRIER
MINIMUM OF 500 FEET OF PAVED SMOOTH
LEVEL ROADWAY (1ST 100 FEET TO BRING
VEHICLE UP TO SPEED WITH ACCELERATION
LESS THAN 0.5 G AND 2ND 100 FEET FOR TEST
DUMMY STABILIZATION.

FIGURE 10

1 l.7 TEST VEHICLE TOW SYSTEM

A guidance system is required to assure that the test vehicle impacts the barrier at the proper angle. At most laboratories, a monorail running down the center of the tow road is used to guide a dolly to which the vehicle is connected. **NO HARD POINT CONNECTIONS BETWEEN THE MONORAIL AND TEST VEHICLE WILL BE ALLOWED.**

A "soft" lateral guidance system is required to assure that the test vehicle will impact the barrier face at the designated 90E angle (straight perpendicular impact). It is suggested that the Contractor's lateral guidance system include steel cables or chains extending from the vehicle lower 'A' arms or front frame rails to the monorail dolly or shoe. The dolly will ride on the monorail and may engage the tow cable through a set of gripper jaws. The dolly will be stopped at the end of the tow road monorail or at the head of the photographic pit releasing the vehicle cables or chains at the same time allowing the vehicle to proceed to the barrier face for impact.

A "soft" connection (seat belt webbing, steel cables, chains, etc.) between the tow cable attachment device and the test vehicle front frame assembly shall be provided by the Contractor. **NO HARD POINT CONNECTIONS BETWEEN THE TOW CABLE AND THE TEST VEHICLE SHALL BE ALLOWED.** The tow cable shall release from the vehicle within (2) feet of the barrier face for precise velocity control of the test vehicle. The vehicle will roll into the barrier at a constant velocity (no acceleration).

The tow system must be capable of ensuring that the test vehicle shall impact the barrier face at the specified speed (35.0 mph ± 0.5 mph (range of 34.5 to 35.5 mph) for Full Frontal Barrier Test

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For the vehicle towing and lateral guidance systems, the performance requirement of"soft" connections is construed to be systems which DO NOT in any way, obstruct or restrain the vehicle structural deformation during impact. Systems that fall to comply with this requirement are interpreted as systems with 'HARD-POINT' connections, and are grounds for retest.

In addition, engagement of the vehicle towing and guidance systems shall NOT alter the natural attitude of the vehicle. Modification of any kind to the test vehicle for towing purposes, should be noted to the COTR.

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11. 8 TEST VEHICLE IMPACT SPEED CONTROL

The speed of the test vehicle must be controlled to obtain and maintain the specified test vehicle speed.

11.9 TEST VEHICLE IMPACT SPEED MEASUREMENT

Primary test vehicle impact speed measurement may be achieved by the use of break wires, photocells, or laser beams located within 5 feet of the barrier. Usually, 2 sets of break wires or 2 photocell transmitters and receivers are used in the final speed trap which records the time, on an electronic counter, for the test vehicle to travel the last 5 feet before barrier impact. The test vehicle's velocity shall be constant (zero acceleration or deceleration) for a minimum of the last 5 feet of travel before impact. The final velocity shall be measured when the front of the test vehicle is within 1 foot of the barrier face, and the reported impact velocity will take into consideration all of the response characteristics of the entire velocity measurement system utilized in its determination.

Impact velocity will be measured by no less than 2 sets of timing devices, and the timing devices shall be accurate to within plus or minus 0.05 mph. The basis for the speed measurement (time and distance) shall be calibrated by an instruments) traceable to the National Institute of Standards and Technology (NIST). The impact velocity shall be permanently recorded.

A timing device shall monitor the velocity of the test vehicle to permit aborting the test if the vehicle's speed is outside of the specified velocity range. A third timing device may be placed along the tow road at a sufficient distance from the barrier face for monitoring the velocity of the test vehicle and permit aborting of the test if the vehicles speed is outside the specified velocity range of 34.5 to 35.5 mph.

Test vehicle impact speed measurement can also be calculated from the high speed photographic film. While the test vehicle is resting against the barrier face for pretest preparations, a stadia pole will be placed directly in line with one of the 12 inch photographic targets as viewed through the broadside camera bore sight.

11.10 ABORT SYSTEM

Each test vehicle shall be equipped with an on-board abort system. The test vehicle on-board abort system shall consist of a remote, gas actuated, brake machine installed in the vehicle's brake line. When an abort function is initiated, the test vehicle service brakes are actuated by releasing high-pressure gas into the hydraulic brake system. Abort criteria consists of vehicle velocity, data acquisition and instrumentation system readiness, and stability of the test vehicle on the tow road. The first two criterion are to be automatically monitored by the test control system while the third is visually monitored by the test director. Manual abort provisions may be available to the test director and the chief instrumentation engineer. The laboratory shall establish safeguards to avoid inadvertent test abort immediately prior to impact. Abort control from the control console will be available at least until the vehicle reaches the location beyond which it is impossible to stop the test

vehicle without impacting the barrier.

An aborted test can be restarted only after notification of the COTR, and dummy positioning and vehicle preparation has been completely redone.

11.11 STATIC ROLLOVER MACHINE

The rollover machine must be capable of rotating the barrier impacted test vehicle about its longitudinal axis with the axis kept horizontal, to each successive increment of 90E, 180E, and 270E at a uniform rate, with 90E of rotation taking place in any time interval from 1 to 3 minutes. Leakage will be collected for the 5 minute period from the beginning of rotation plus any additional 1 minute collection periods that are required. Containers for the collection of possible Stoddard solvent spillage and a calibrated stopwatch for timing the fluid collection intervals are required. Containers must be labeled before they are photographed.

11.12 ELECTROMAGNETIC INTERFERENCE (EMI)

The laboratory shall take all necessary precautions to assure electromagnetic interference with the test data does not occur. The following procedures shall be included in those adopted by the laboratory:

A. Ground the head, thorax, and both femurs of the anthropomorphic test devices. This is accomplished by connecting the four components with a wire. A single wire then exits the dummy and is attached to a grounding block on the vehicle. Connect the grounding block to earth ground. The actual wire size and connections are left to the laboratory based on the system it uses.

13. Use a static electricity elimination spray on the dummies and the interior of the vehicle.

C. If laboratory data acquisition system is susceptible to EMI, it is recommended that the OEM battery be drained in an environmentally sound manner, and the cables be disconnected from the battery. Then secure an auxiliary battery in the trunk or cargo area and connect it to the battery cables in the engine compartment. The replacement battery voltage and performance must be the same as that of the OEM battery.

D. Ground metallic parts of pit covers and use a static electricity elimination spray on nonmetallic pit covers.

11.13 TEST DATA ACQUISITION AND REDUCTION

Note: Parts of the following may not apply to on-board data acquisition systems.

Prior to the vehicle crash test, a null reference and a shunt calibration adjustment is performed to set all analog and direct digitized data devices including FM magnetic tape recorders. Immediately following the crash test, a post impact null reference and shunt calibration check will be performed. The pre and post test zero and shunt calibration check will be recorded and the data submitted with the report as shown below:

CHANNEL DESCRIPTION	S/N	DLR	UNITS	PRE-ZERO	PRE-CAL	POST-ZERO	POST-CAL
Head x	123abc	106.1	G's	0.045	2.202	.045	2.203
Head y							

As a secondary instrumentation check, it is suggested that just prior to vehicle testing, accelerometers and on-board signal conditioning equipment be lightly tapped with a rubber mallet to ensure that sensors are recording, and that instrumentation connections are secure.

Prior to initiation of the testing program and periodically thereafter, on-board equipment should be dropped tested and performance checked at G levels expected in the NCAP testing. The equipment should be sufficiently shock hardened to function in the adverse environment. In addition, it is recommended that on a periodic basis, the instrumentation be energized with the sensors removed from the system. The system should then be subjected to a shock equivalent to that in the crash test event. The output voltages should remain stable confirming system integrity.

Analog data is prefiltered (Class 1000) and digitized at a minimum, rate of 10,000 samples per second. The data is then placed into permanent storage on a magnetic disk or tape after the application of appropriate calibration scale factors.

As the data is recalled for integration or plotting, the appropriate filter is applied. These filters are in accordance with SAE Recommended Practice J211 (Appendix I)"Instrumentation for Impact Tests." Vehicle acceleration data is plotted after the application of an SAE Class 60 filter, and velocity and displacement data is plotted after the application of an SAE Class 180 filter.

Before plotting, the Contractor's program manager or engineer shall determine the ‘time zero', which is verified with the trigger signal. When a velocity or displacement trace is to be plotted, integration for the appropriate acceleration signal is performed digitally.

NOTE:

1. Time zero bias should be removed prior to submission of the data tape disk to NHTSA.

2. Reported HIC and Chest Clip injury measures in test report should be rounded to One significant decimal place according to accepted rounding practices.

FILTERING REQUIREMENTS

A. Class 1000 for dummy Head data/Neck forces/Pelvic/Foot Acceleration

B. Class 600 for dummy Femur data/Neck moments/Tibia Forces and Moments

C. Class 180 for dummy Chest data (acceleration and chest displacement)

D. Class 60 for vehicle accelerometer/Load cell barrier/ Belt loading and Displacement.

As stated previously, the minimum sampling rate requirement is 10,000 samples per second per channel. The Contractor must meet all the requirements in the NHTSA"Data Tape Reference Guide' which is available from the following organization:

National Highway Traffic Safety Administration
Office of Vehicle Safety Research
Crashworthiness Research Division
400 Seventh Street, SW
Mail Code: NRD-11
Washington, DC 20590
Telephone No.: 202-366-4714 Barbara Hennessey

Or check the web site at:
http://www-nrd.nhtsa.dot.gov/nrd10/software
click on **Test Reference Guides**

ALGORITHMS USED TO CALCULATE THE HEAD INJURY CRITERION (HIC), TO DIGITALLY FILTER THE CLASS 1000 DATA, AND TO CALCULATE THE THREE MILLISECOND CLIPS OF A WAVEFORM WILL BE PROVIDED BY THE GOVERNMENT.

Information for four (4) FORTRAN algorithms that are used to calculate the HIC, to digitally filter the Class 1000 data collected from the frontal barrier impact tests, and to calculate the 3 millisecond clips of a waveform are found in **Appendix E**.

A listing of the variables required by the furnished algorithms shall also be supplied to the Contractor.

For the various filter classes, the following cut-off frequencies shall be required:

CLASS	CUT-OFF FREQUENCY
60	100
180	300
600	1000
1000	1650

A tape/diskette containing the most recent versions of the algorithms can be obtained from the agency. Any questions pertaining to the algorithms or requests for the algorithms should be directed to the following organization:

National Highway Traffic Safety Administration
Office of Vehicle Safety Research
Crashworthiness Research Division
400 Seventh Street, SW
Mail Code: NRD-11
Washington, DC 20590
Telephone No.: 202-366-4712 Steve Summers

If a Contractor is not presently certified as defined by the "Data Tape Reference Guide", the same organization should be contacted. A Contractor is not considered qualified for test work described herein without this certification.

FIGURE 11 outlines a typical vehicle and occupant impact data acquisition system.

NOTE: (may not apply for on-board data acquisition systems) All data collected must be recorded on a magnetic analog tape which conforms to the data acquisition and processing qualification requirements. Direct data tape recording is acceptable and encouraged provided the magnetic tape is simultaneously in operation and the direct system conforms to the data acquisition qualification requirements.

11.3.1 RECOMMENDED DATA TRACE ORDER

To insure uniformity in data tape formatting, the following curve order is recommended:

Driver
Head x ,y ,z Acceleration Primary
Head x ,y ,z Acceleration Redundant
Neck x, y, z Force
Chest x ,y ,z Acceleration Primary
Chest x ,y ,z Acceleration Redundant
Chest Compression
Pelvic x ,y ,z Acceleration
Left Femur Force
Right Femur Force
Left Leg Upper Tibia Moment x
Left Leg Upper Tibia Moment y
Left Leg Lower Tibia Moment x
Left Leg Lower Tibia Moment y
Left Leg Lower Tibia Force z
Right Leg Upper Tibia Moment x
Right Leg Upper Tibia Moment y
Right Leg Lower Tibia Moment x
Right Leg Lower Tibia Moment y
Right Leg Lower Tibia Force z
Left Ankle x , z Acceleration
Left Foot z Acceleration
Right Ankle x , z Acceleration
Right Foot z Acceleration
Lap Belt Force
Shoulder Belt Force
Shoulder Belt Spool-off
Shoulder Belt Elongation

PASSENGER TRACES (same order as driver)
VEHICLE
Left Rear Acceleration Primary
Right Rear Acceleration Primary
Engine Top Acceleration
Engine Bottom Acceleration
Left Brake Caliper Acceleration
Right Brake Caliper Acceleration
Instrument Panel Acceleration
Left Rear Acceleration Redundant
Right Rear Acceleration Redundant
LOAD CELL BARRIER
LCB A1 -A9
LCB B1 -A9
LCB C1 -A9
LCB D1 -A9

TYPICAL VEHICLE AND OCCUPANT IMPACT TEST DATA ACQUISITION SYSTEM

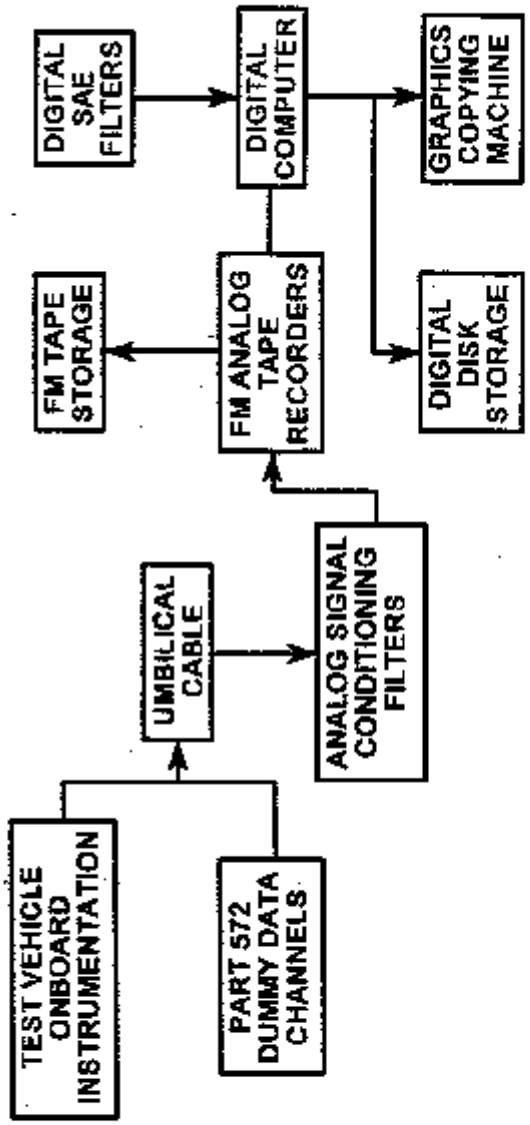


FIGURE 11

12. NCAP TEST EXECUTION AND TEST REQUIREMENTS

12.1 Intentionally Blank

12.2 VEHICLE TEST WEIGHT

After the test vehicle is received, fluids will be added to specified levels or filled to capacity and the vehicle weight recorded at each wheel to determine the "unloaded vehicle weight" (UVW). Ballast must be contained so that it will not shift during the impact event or interfere with data collection or interfere with high speed film recordings or affect the structural integrity of the vehicle or do anything else to affect test results. Care must be taken to assure that any attachment hardware added to the vehicle is not in the vicinity of the fuel tank or lines.

12.2.1 PASSENGER CARS

A passenger car shall be loaded to its unloaded vehicle weight (UVW) plus its rated cargo and luggage capacity weight (RCLW) secured in the luggage area, plus two 50th-percentile adult male test dummies located at the front outboard designated seating positions. This is defined as the **FULLY LOADED** condition.

FMVSS 110 requires that the vehicle capacity weight (VCW) and the designated seating capacity (DSC) be recorded on the tire information placard. This information can be used to determine the "rated cargo and luggage weight' (RCLW) as follows:

RCLW = VCW - (150 lb x DSC)

The Calculated Test Vehicle Target Weight (TVTW) can now be calculated as follows:

CALCULATED TEST VEHICLE TARGET WEIGHT = UVW +RCLW + [(2 dummies) x (Dummy weight)]

ACTUAL TEST WEIGHT MUST = CALCULATED TEST VEHICLE TARGET WEIGHT - (1 0 to 20 pounds)

Load the vehicle with the required test dummies and necessary on-board test equipment and cameras and then add ballast to achieve the actual test weight. The load placed in the cargo area shall be centered over the longitudinal centerline of the vehicle.

12.2.2 MULTIPURPOSE PASSENGER VEHICLES, TRUCKS AND BUSES

A multipurpose passenger vehicle (MPV), truck or bus is loaded to its UVW, plus 300 pounds or its RCLW, whichever is less, plus two 50^{th} percentile adult male test dummies located at the front outboard designated seating positions.

Where the VCW is not provided on the label it can be calculated by the following formula:

VCW = GVW - UVW (maximum UVW is 5,500 pounds)
RCLW = VCW - (150 lb/DSC x DSC)

The CALCULATED TEST VEHICLE TARGET WEIGHT can now be calculated as follows:

CALCULATED TEST VEHICLE TARGET WEIGHT = UVW + RCLW + [(2 dummies) x (Dummy weight)]

* or 300 pounds whichever is less

ACTUAL TEST WEIGHT MUST = CALCULATED TEST VEHICLE TARGET WEIGHT - (10 to 20 pounds)

Load the vehicle with the required test dummies and necessary on-board test equipment and then add ballast to achieve the actual test weight. The load added to obtain the test weight (including test equipment) shall be secured in the-load carrying area and, with the dummies in the front outboard positions, shall be distributed as nearly as possible to obtain the proportion of axle weight indicated by the gross axle weight ratings. The load placed in the cargo area shall be centered over the longitudinal centerline of the vehicle.

If the CALCULATED TEST VEHICLE TARGET WEIGHT (TVTW) is exceeded, the program manager or engineer must notify the appropriate OMI engineer to discuss the possible removal of vehicle components which would decrease the excess weight figure.

To achieve TVTW, certain vehicle components which do not affect vehicle frontal crashworthiness MAY be removed. Removal of any components requires COTR authorization.

Under no circumstances shall the actual vehicle test Weight be greater than the Test Vehicle Target Weight (TVTW). The contractor shall strive to meet the TVTW.

12.3 VEHICLE ATTITUDE

Determine the distance between a level surface, for example a flat roadway, and a standard reference point on the test vehicle's body, directly above each wheel opening, when the vehicle is in its "as delivered" condition. The "as delivered" condition is the vehicle as received at the test site, with 100 percent of all fluid capacities (UVW condition) and all tires inflated to the manufacturer's specifications as listed on the vehicle's tire information label or placard. Determine the distance between the same level surface or reference plane and the same standard reference points in the vehicle's 'fully loaded condition'. The 'fully loaded condition' is the test vehicle loaded in accordance with Section 12.2.(UVW + RCLW + 2 dummies). The load placed in the cargo area shall be centered over the longitudinal centerline of the vehicle. The pretest(testing condition) vehicle attitude shall be equal to either the as delivered or fully loaded attitude or. between the as delivered attitude and the fully loaded attitude.

12.4 VEHICLE FLUIDS

Drain the fuel system and operate the engine until the fuel system is dry. Slowly refill the entire fuel system (rotate engine) with Stoddard solvent which has been dyed purple, having the physical and chemical properties of Type 1 solvent or cleaning fluid, Table 1, ASTM Standard D484-71, "Standard Specifications for Hydrocarbon Dry-cleaning Solvents" until, not less than 92 percent and not more than 94 percent, of the vehicle manufacturer's stated "usable capacity" is reached. This volume will be furnished by the COTR. The Stoddard solvent must be filtered while being introduced into the fuel system. Drain all other fluids from the test vehicle with the exception of brake fluid if required for abort system, so that Stoddard solvent leakage from the fuel system will be evident. Just prior to the test, operate the engine ("crank"), to assure that Stoddard solvent is present throughout the entire fuel system.

> It is permissible to cut small holes in coolant hose and transmission torque converters to assure that all fluid other than Stoddard solvent has been removed from the vehicle.

As indicated in Section 11.12, if the testing laboratory data acquisition system is susceptible to electromagnetic interference (EMI), then the **BATTERY** should be drained in an environmentally sound manner, and replaced with an equivalent auxiliary battery secured in the trunk for power. Otherwise, the OEM fully charged battery can be utilized. The COTR is to be notified as to which method will be used.

NOTE: If EMI is not a factor, an auxiliary battery can be used in the trunk of the vehicle and connected in parallel with the fully charged OEM battery in the engine compartment. This will insure full power to the vehicle systems.

12.5 WINDSHIELD PERIPHERY MEASUREMENT

Most vehicle windshields are either bonded in place and covered with chrome or plastic strips or they are held to the body by a rubber retainer. It is difficult to determine the exact periphery of the windshield because the glazing edge is hidden from view. The test engineer will measure the perimeter inside the retainer or molding at several locations. After the impact test the covering over the glazing edge may be removed for exact measurement of the windshield periphery. Do not disturb the molding or retainer in the event of a noncompliance.

12.6 WINDSHIELD ZONE INTRUSION

When a passenger car, multipurpose passenger vehicle (MPV), light truck or bus (GVWR of 10,000 pounds or less) traveling longitudinally forward at 29.4.mph ± 0.5 mph impacts a fixed collision barrier that is perpendicular to the line of travel of the vehicle (PERPENDICULAR FRONTAL IMPACT TEST), no part of the vehicle outside the occupant compartment, except windshield molding and other components designed to be normally in contact with the windshield, shall penetrate the protected zone template (a template is not used when NCAP testing is performed), affixed to the windshield, to a depth of more than 0.25 inch, and no such part of the vehicle shall penetrate the inner surface of that portion of the windshield, within the Daylight Opening (DLO) below the protected zone.

NOTE: The standard does NOT apply to forward control vehicles, walk-in van-type vehicles, or to open-body-type vehicles with fold-down or removable windshields.

Protected zone template (These instructions are only used to determine the protected zone of the windshield and should not be construed to mean a template should be placed on the windshield). The lower edge of the protected zone is determined as follows:

A. Place a 6.5 inch diameter rigid sphere weighing 15 pounds in a position such that it simultaneously contacts the inner surface of the windshield glazing and the surface of the instrument panel, including padding.

B. Draw the locus of points on the inner surface of the windshield contacted by the sphere across the width of the instrument panel. From the outer most contactable points, extend the locus line horizontally to the edges of the glazing material. NOTE: Do not scratch glazing as a method of marking the contact between sphere and windshield.

C. Draw a line on the inner surface of the windshield below and 0.5 inch distant from the locus line.

D. The lower edge of the protected zone is the longitudinal projection onto the outer surface of the windshield on the line determined in item C.

The protected zone is the space enclosed by the following surfaces:

A. The outer surface of windshield in the pre-crash configuration.

B. The focus of points 3 inches outward along perpendiculars drawn to each point on the outer surface of the windshield.

C. The locus of lines forming a 45E angle with the outer surface of the windshield at each point along the top and side edges of the outer surface of the windshield and the lower edge of the protected zone previously determined, in the plane perpendicular to the edge at that point.

12.7 TEST TEMPERATURE CONDITIONS

The Contractor must verify that the dummy temperature is in the specified temperature range (Hybrid III - 69EF to 72EF) by either of the following two methods:

A. The dummy must be soaked in an ambient air environment in the specified range as shown above for 16 hours prior to the test and any time after that until just before the movement of the vehicle towards the impact barrier. The ambient air temperature must be monitored and continuously recorded within 36 inches of the dummies. If at any time the ambient air temperature is not in the specified range, as shown above, the dummy part temperature measurement of Method B must be used prior to the impact test to verify a stabilized dummy temperature.

B. The dummy must be soaked in an ambient air environment in the specified range (Hybrid III - 69EF to 72EF) for 16 hours prior to the test. The ambient temperature must be monitored and continuously recorded until just before impact. The temperature of the following dummy parts must be monitored and continuously recorded at least 30 minutes prior to the impact test.

(1) The outside surface temperature of the forehead. (remove this sensor immediately prior to the test)
(2) The surface temperature of the spine box. (this is in the internal portion of the dummy)
(3) The outside surface temperature of the neck. (remove this sensor immediately prior to the test)
(4) The outside surface temperature of the one knee. (remove this sensor immediately prior to the test)

The chalk coating may be put on the face and knee around the sensor. The sensors shall be taped into place on the outer surfaces of the dummy and secured to the spine box for

the internal sensor.

When the temperature of these four components has reached the applicable temperature range as listed above, and has remained in that range for 30 continuous minutes, the impact test may be performed.
It is not the intent of Method B to have the dummy outside the ambient air temperature range that corresponds to the specified dummy temperature range listed above. However, the purpose is to confirm that the dummy is still at the proper stabilized temperature even if there are short fluctuations of ambient air temperature outside the range specified for the dummy temperature. Therefore, if there is an ambient air temperature excursion outside the specified dummy temperature range, the Contractor must work quickly to bring the ambient air temperature back into that range.

The temperature sensors for both methods shall be accurate at least to within ± 0.5EF.

The Contractor shall mark the ambient air temperature recording with the date, time and technician name at the beginning of the 16 hour soak and when the vehicle begins to move towards the barrier. The dummy part temperature recordings shall also be marked at the beginning and end with the date, time, and technician's name. Any excursions from the specified temperature must be noted on the recording along with the reason for the excursion. Temperature recordings shall be included in the final test report. The windshield mounting material and all vehicle components in direct contact with the mounting material must be at a temperature between 15EF and 110EF. This temperature measurement must be made within 15 minutes of the impact test event.

12.8 ADDITIONAL PRE-IMPACT INSTRUCTIONS

A. Record pretest vehicle length and width measurements for calculation of vehicle static crush as shown in sample test report. THIS INCLUDES AAMA DOOR OPENING WIDTH MEASUREMENTS, STATIC FOOTWELL DEFORMATION, AND PASSENGER COMPARTMENT INTRUSION.

B. *Adjustable seat cushions* are in the adjustment position midway between the forward most and rearmost positions, and if separately adjustable in a vertical direction, are at the lowest position. If an adjustment position does not exist midway between the forward most and rearmost positions, the next closest adjustment position to the REAR of the midpoint is used. Insure visually with a mirror and light that the seat detents are properly engaged.

The number of adjustment positions or detents in the seat track shall be visually determined and recorded.

The fore and aft extremes of adjuster travel and the midpoint shall be marked on the vehicle's side sill trim cover plate with a reference line added to the outboard side of the seat cushion(s) such that side photographs taken with the door open show pre- and post-crash test seat positions.

C. Place adjustable seat backs in the manufacturer's nominal design riding position in the manner specified by the manufacturer. (Information furnished by the COTR.)

Place any adjustable anchorages at the manufacturer's nominal design riding position for a 50th percentile adult male (50M) occupant. (Furnished by the COTR.)

Place each adjustable head restraint in its highest adjustment position.

Adjustable lumbar supports are positioned so that the lumbar support is in its lowest or rearmost adjustment position.

D. Adjustable steering controls are adjusted so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If there is no midpoint of vertical swing, placement shall be made according to the manufacturers nominal design position provided by the COTR.

Telescoping wheels are to be positioned according to manufacturer specifications.

L) When a seat belt with an adjustable anchorage is used, put the anchorage in the manufacturer's nominal design position for a 50th percentile adult male occupant. This position should be noted in test report.

F. Front driver and passenger windows are to be in the fully retracted (open) position and the rear windows fully closed. Other movable vehicle windows and vents are, at the manufacturer's option, placed in the fully closed position.

G. Convertibles and open-body type vehicles have the top, if any, in place in the closed passenger compartment configuration.

H. The windshield mounting-material and all vehicle components in direct contact with the mounting material are at any temperature between 15EF and 110EF.

I. Check to assure that the instrumentation and wires do not affect the motion of the dummies during the impact event or static rollover following impact.

J. All tires will be inflated to the vehicle manufacturer's specifications which are listed on the tire information placard or label affixed to the test vehicle (usually on the left B-post).

K. Parking brake is disengaged and the transmission is placed in "Neutral".

L. Turn the vehicle ignition key to the "ON" position. Air bag readiness indicator shall be checked to verify air bag system is operational.

M. Doors are fully closed and latched but not locked.

N. Adjustable cowl tops or other adjustable panels in front of the windshield are in the position used under normal operation during inclement weather.

0. The hood, hood latches, and any other hood retention components are engaged.

P. Contractor add-on items, such as instrumentation, cameras, lights, etc., shall not interfere with dummy motion and restraint system operation. Items with sharp edges should be avoided.

12.9 TEST DUMMIES

For NCAP barrier impact tests, a Part 572 Subpart E test dummy shall be placed at the front outboard seating positions.

Each test dummy shall be clothed in form fitting cotton stretch garments with short sleeves and mid calf length pants. The driver and passenger dummies' clothes shall be contrasting colors so the motion of each can be tracked on the high speed film during film analysis. Each foot of the dummy shall be equipped with a size 11EE shoe which meets the configuration, size, sole, and heel thickness specifications of MIL-S-13192 and weighs 1.05 pounds to 1.45 pounds.

All dummy joints should be inspected for mobility prior to each crash test and reset to hold between 1 and 2 g's. This amount of friction will just barely restrain the weight of the individual limb when it is extended horizontally.

Place test dummies in the test vehicle the morning of test day. Do not place the dummies in the vehicle the day before testing for overnight storage.

The final positions of the driver and passenger dummies shall be recorded using the appropriate final report data sheet, and the occupant clearances to vehicle interior surfaces dimensions shall be recorded on a separate data sheet.

The dummy calibration procedure is attached as **Appendix A.** The calibration data for each dummy used in a vehicle barrier impact test shall be included in the final test report.

Dummy positioning procedures are detailed in **Appendix B.**
Manufacturer's representatives will be afforded the opportunity to take measurements of the dummies' positions after the dummy positioning procedures are complete. Any deviation from this procedure must be approved by the COTR.

The dummies shall be alternated in the driver's and passenger's seat. For example, if three dummies are prepared for each test, the driver dummy from the previous test will become the spare, the

passenger dummy from the previous test will be the driver, and the spare from the previous test will be the passenger.

12.10 FUEL SYSTEM INTEGRITY

12.10.1

After the vehicle impact, fuel system Stoddard solvent leakage will be collected by hand and documented with a real-time (24 fps) motion picture camera and stop watch. The "tea cup method" involves simply placing a collection vessel beneath the leakage source and timing the intervals of several collected volumes. The collected Stoddard solvent samples can subsequently be measured and spillage rates calculated. If the "tea cup method" is used, the test personnel must be in position to scramble to observation points around the test vehicle at the instant the vehicle comes to rest after the impact event.

12.10.2 Static Rollover for FMVSS 301

The Contractor must conduct a static rollover test within 30 minutes after the vehicle impact. The Contractor must keep the test vehicle under constant observation for Stoddard solvent leakage during the transition between impact and static rollover testing.

When the test vehicle is rotated in a fixture on its longitudinal axis to each successive increment of 90E, following an impact crash, Stoddard solvent spillage, from the onset of rotational motion, shall not exceed a total of 5 ounces by weight for the first 5 minutes of testing at each successive 90E increment. For the remaining testing period, at each increment of 90E, solvent spillage during any l-minute interval shall not exceed 1ounce by weight.

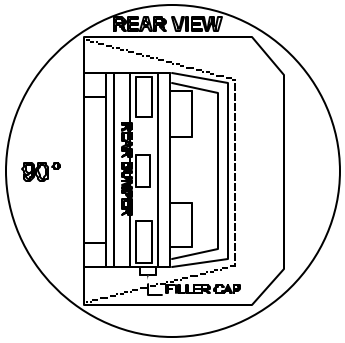
Static rollover test conditions-

Within 30 minutes after a vehicle impact, the vehicle is rotated in a test fixture about its longitudinal axis, with the axis kept horizontal, to each successive increment of

(1) 90E
(2) 180E
(3) 270E
(4) 360E

at a uniform rate, with 90E of rotation taking place in any time interval from 1 to 3 minutes.

After reaching each 90E increment the vehicle is held in that position for 5 minutes.



The rollover machine must be capable of rotating the barrier impacted test vehicle about its longitudinal axis with the axis kept horizontal, to each successive increment of 90E, 180E, and 270E at a uniform rate. Leakage will be collected for the 5 minute period from the beginning of rotation plus up to three 1 minute collection periods. Containers for the collection of possible Stoddard solvent spillage and a calibrated stopwatch for timing the fluid collection intervals are required. Containers must be labeled before they are photographed.

13. POST TEST REQUIREMENTS

Collect all data necessary to complete the final test report data sheets and provide details of any problem areas.

The protected zone and windshield retention must be checked directly after a frontal barrier impact. Loss of windshield protection can be determined when a piece of paper can pass between the windshield edge and the vehicle body. Photographs of the windshield periphery should be taken before the vehicle is placed in the FMVSS 301 static rollover machine. Rollover should occur within 30 minutes after the vehicle impact. Any fluid spillage shall be collected by hand-held catch pans and documented with real-time camera and a stop watch. After crash testing, the vehicle shall be transported to the vehicle storage area by use of a fork lift truck. The forks of the lift truck shall be extended underneath the crashed test vehicle in such a manner as to minimize fuel system component damage.

14. REPORTS

14.1 MONTHLY STATUS REPORTS

The Contractor shall submit a monthly Test Status Report and a Vehicle or Equipment Status Report to the COTR (both reports shown in this section). The Vehicle Status Report shall be submitted until all vehicles or items of equipment are disposed of.

14.2 TEST ANOMOLIES

In the event of an apparent test failure, a post test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional costs to the OCS.

MONTHLY TEST STATUS REPORT

NCAP

DATE OF REPORT: _____

No.	Vehicle NHTSA No., Make and Model	Test Date		Date Report Submitted	Date Invoice Submitted	Invoice Payment Date
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

MONTHLY VEHICLE STATUS REPORT

NCAP

DATE OF REPORT: _____

No.	Vehicle NHTSA No., Make and Model	Date of Delivery	Odometer Reading	Test Complete Date	Vehicle Shipment Date	Odometer Reading
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

14.3 FINAL TEST REPORT

14.3.1 COPIES

SEVEN (7) CD's and THREE paper copies of each Final Test Report, FIVE copies of the test film, ONE disk in Word Perfect format of the text and data sheet portion of the test report, and ONE copy of the data tape/diskette shall be submitted to the COTR according to the schedule indicated in section 6.

Payment of Contractor's invoices for completed NCAP tests may be withheld until the Final Test Report is accepted by the COTR. Contractors are requested to NOT submit invoices before the COTR is provided copies of the Final Test Report.

Contractors are required to submit one copy of each Final Test Report in draft form. The COTR will review the draft report and notify the laboratory of any corrections prior to submission of the final reports.

Contractors are required to PROOF READ all Final Test Reports before submittal to the COTR. The OCS will not act as a report quality control office for Contractors. Reports containing a significant number of errors will be returned to the Contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

14.3.2 REQUIREMENTS

The Final Test Report, associated documentation (including photographs) are relied upon as the chronicle of the NCAP test. The Final Test Report will be released to the public domain after review and acceptance by the COTR. For these reasons, each final report must be a complete document capable of standing by itself.

The Contractor should use detailed descriptions of all NCAP test events. Any events that are not directly associated with the NCAP but are of technical interest should also be included. The Contractor should include as much detail as possible in the report.

Instructions for the preparation of the first three pages of the final test report are provided below for the purpose of standardization.

14.3.3 FIRST THREE PAGES

Front Cover - - A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

(A) Final Report Number such as NCAP-ABC-9X-001

where - -

NCAP is the test
ABC are the initials for the laboratory
9X is the Fiscal Year of the test program
001 is the Group Number (00 1 for the 1st test, 002 for the 2nd test, 003for the 3rd test, etc.)
-

(B) Final Report Title And Subtitle such as

NEW CAR ASSESSMENT PROGRAM (NCAP)
Test Type (Full Frontal Barrier Impact Test)
****
World Motors Corporation
199X XYZ 4-door sedan
NHTSA No. CX0401

(C) Contractor's Name and Address such as

XYZ TESTING LABORATORIES, INC.
4335 West Dearborn Street
Detroit, Michigan 48090

NOTE: DOT SYMBOL WILL BE PLACED BETWEEN ITEMS (C) AND (D)

(D) Date of Final Report completion

(E) The words "FINAL REPORT"

(F) The sponsoring agency's name and address as follows

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Safety Performance Standards
Office of Crashworthiness Standards
Mail Code: NPS-10
400 Seventh Street, SW, Room 5313
Washington, DC 20590

14. REPORTS .... Continued

First Page After Front Cover - - A disclaimer statement and an acceptance signature block for the COTR shall be provided as follows:

> This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared By: _____

Approved By: _____

Approval Date: _____

FINAL REPORT ACCEPTANCE BY OCS:

_____
Manager, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

_____
COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

14. REPORTS .... Continued

Second Page After Front Cover - - A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

Block No. 1 - - REPORT NUMBER

NCAP-ABC-9X-001

Block No. 2 - - GOVERNMENT ACCESSION NUMBER

Leave blank

Block No. 3 - - RECIPIENT'S CATALOG NUMBER

Leave blank

Block No. 4 - - TITLE AND SUBTITLE

Final Report of NEW CAR ASSESSMENT PROGRAM Testing
of a 199X World XYZ Deluxe 4-door sedan
NHTSA No. CX0401

Block No. 5 - - REPORT DATE

March 1, 199X

Block No. 6 - - PERFORMING ORGANIZATION CODE

ABC

Block No. 7 - - AUTHOR(S)

John Smith, Project Manager
Bill Doe, Project Engineer

Block No. 8 - - PERFORMING ORGANIZATION REPORT NUMBER

ABC-DOT-XXX-001

Block No. 9 - - PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories405 Main Street

Detroit, Ml 48070

14. REPORTS .... Continued

Block No. 10 - - WORK UNIT NUMBER

Leave blank

Block No. 11 - - CONTRACTOR GRANT NUMBER

DTNH22-9X-D-1 2345

Block No. 12 - - SPONSORING AGENCY NAME AND ADDRESS

US Department of Transportation
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NPS-10
400 Seventh Street, SW, Room 5313
Washington, DC 20590

Block No. 13 - - TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Feb. 15 to Mar. 15, 199X

Block No. 14 - - SPONSORING AGENCY CODE

NPS-10

Block No. 15 - - SUPPLEMENTARY NOTES

Leave blank

Block No. 16 - - ABSTRACT

NCAP tests were conducted on the subject 199X World XYZ 4-door sedan in accordance with the specifications of the Office of Crashworthiness Standards Test Procedure No. TP-NCAP-XX for the determination of vehicle crashworthiness.

Block No. 17 - - KEY WORDS

35 mph Frontal Barrier Impact test
New Car Assessment Program (NCAP)

14. REPORTS .... Continued

Block No. 18 - - DISTRIBUTION STATEMENT

Copies of this report are available from the following:

NHTSA Technical Reference Division
National Highway Traffic Safety Admin.
400 Seventh St., SW, Room 5108
Washington, DC 20590

Block No. 19 - - SECURITY CLASSIFICATION OF REPORT

Unclassified

Block No. 20 - - SECURITY CLASSIFICATION OF PAGE

Unclassified

Block No. 21 - - NO. OF PAGES

Add appropriate number

Block No. 22 - - PRICE

Leave blank

14.3.4 TABLE OF CONTENTS **PAGE NO.**

Sample Test Report **Table of Contents:**

A. Section 1 - Purpose and Summary of NCAP Test

B. Section 2 - Occupant and Vehicle Information/Data Sheets

C. Section 3 - Photographs

D. Section 4 - Dummy, Vehicle, and Load Cell Barrier response data traces.

E. Section 5 - Dummy Calibration

F. Section 6 - Test Equipment and Instrumentation Calibration

14. REPORTS .... Continued

14.3.5 SAMPLE TEST REPORT INFORMATION

DATA SHEET LISTING

DATA SHEET NO.	**DESCRIPTION**
1	Crash Test Summary
2	General Test and Vehicle Parameter Data
3	Post Impact Data
4	Test Vehicle Information
5	Dummy Positioning in Vehicle
6	Seat Belt Positioning Data
7	Vehicle Accelerometer Location And Data Summary
8	Dummy Injury Criteria Values
9	Seat Belt Performance Data
10	Summary of FMVSS 212 Data
11	Windshield Zone Intrusion FMVSS 219 Data
12	FMVSS 301 Fuel System Integrity Data
13	FMVSS 301 Rollover Data
14	Vehicle Measurements
15	Camera Data
16	Reference Photo Targets
17	Load Cell Locations on Fixed Barrier

18 Post Test Air Sag Data

19 Accident Investigation Division Data

SECTION I

PURPOSE AND SUMMARY OF TEST MT001

PURPOSE This 35 mph (56.9 kph) frontal barrier impact test is part of the Composite FY 95 New Car Assessment Program (NCAP) sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract No.DTNH22-95-d-xxxxx. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for an impact speed in excess of the current 30 mph (48.3 kph) FMVSS 208/212/219/301 requirements.

The 35 mph frontal barrier test was conducted in accordance with the Office of Crashworthiness Standards (OCS) Laboratory Indicant Test Procedure.

SUMMARY A load cell barrier consisting of 36 load cells was impacted by a 199X Buick Electra 4-door sedan at a velocity of 56.9 kph. The test was conducted at XYZ Laboratories on April 15, 1995 at a speed of 56.9 kph. The frontal barrier impact event was documented by one real-time camera and 16 high-speed cameras. Two Part 572E, 50th percentile male anthropomorphic test devices (ATDS) were placed in the driver right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

Both ATDs were instrumented with head, chest, pelvic, and redundant head and chest triaxial accelerometers, left/right femur load cells, and left/right lower leg sensors. In addition, chest displacement and neck six-axis load and moment sensors were utilized. The driver's and passenger's restraint systems were instrumented with load cells to measure lap and shoulder belt forces and potentiometers to measure shoulder belt stretch and spoolout. The 121 channels of data were recorded on a PC based data acquisition system and on six 14-channel FM tape recorders.

The driver ATD (Serial No. xxx) and the right-front passenger ATD (Serial No. yyy) were used in one previous test (MT0107). Injury criteria were not exceeded in test MT0107.

The driver's head HIC was 750, maximum chest deceleration over 3 milliseconds was 45 G's, and the left and right femur loads were 1000 and 2000 newtons respectively.

The right front Passenger's HIC was 750. Maximum chest deceleration over 3 milliseconds was 45 G's, and the left and right femur loads were 1000 and 2000 newtons respectively.

There was 100 percent windshield retention, no intrusion into the protected or unprotected zone of the windshield, and no Stoddard solvent leakage after impact or during any, phase of the static rollover test.

15. DATA SHEETS

SECTION 2

DATA SHEET NO. 1

CRASH TEST SUMMARY

Vehicle NHTSA No. : _____ Test Mode : _____

Test Date : _____ Time: _____ Temperature : _____ °C

Vehicle Make/Model/Body Style : _____

Vehicle Test Weight : _____ kg

Vehicle/Barrier Impact Angle : _____ °

Impact Velocity : _____ kph

Maximum Static Crush : _____ mm

Vehicle Rebound : _____ mm

DUMMIES:	**DRIVER**	**PASSENGER**
Type :		
Restraint System :		

Number of Data Channels : _____

Number of Cameras : _____ Real Time

_____ High Speed

DOOR OPENING DATA : _____ - Left Front

_____ - Right Front

Front Seat(s) Data :	**DRIVER**	**PASSENGER**
Seat Track Failure :(mm of shift)		
Seat Back Failure :		

VISIBLE DUMMY CONTACT POINTS :	**DRIVER**	**PASSENGER**
Head :		
Abdomen :		
Chest		
Knees		

15. DATA SHEETS ..... Continued

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

TEST VEHICLE INFORMATION :

Year/Make/Model/Body Style : _____

NHTSA No. : _____; VIN: _____; Color : _____

Engine Data: _____cylinders; _____CID; _____Liters; _____cc

Placement : _____Longitudinal or In-Line; _____ Transverse or Lateral

Transmission Data : _____speeds; _____Manual; _____Automatic; _____Overdrive

Final Drive : ____Rear Wheel Drive; ____Front Wheel Drive; _____Four Wheel Drive

Major Options : _____ A/C; _____ Pwr.Strg.; _____ Pwr. Brakes

_____Pwr. Windows; ____-____Pwr. Door Locks; _____ Tilt Wheel

Date Received : _____; Odometer Reading _____km

Selling Dealer : _____

& Address: _____

DATA FROM TIRE VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by : _____

Date of Manufacture _____

GVWR : _____kg; GAWR: _____ kg FRONT; _____ kg REAR

DATA FROM TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load : _____kpa FRONT

_____ kpa REAR

Recommended Tire Size : _____

* Recommended Cold Tire Pressure : _____kpa FRONT; _____kpa REAR

Size of Tires on Test Vehicle: _____; Manufacturer: _____

Vehicle Capacity Data :

Type of Front Seats: _____Bench; _____ Bucket; _____Split Bench

Number of Occupants: _____ Front; _____ Rear; ____0____ Total

Vehicle Capacity Weight (VCW) = _____kg

No. of Occupants x 68 kg = _____kg

Rated Cargo/Luggage Weight (RCLW) = _____kg

*Tire pressure used for test

15. DATA SHEETS ..... Continued

DATA SHEET NO. 2 GENERAL TEST AND VEHICLE PARAMETER DATA (cont.)

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with maximum fluids) = UDW:

Right Front = _____ kg Right Rear = _____ kg

Left Front = _____ kg Left Rear = _____ kg

TOTAL FRONT = _____ kg TOTAL REAR = _____ kg

TOTAL DELIVERED WEIGHT = _____ kg

% of Total Front of Vehicle Weight = _____ % of Total Rear Weight = _____ %

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT :

Total Delivered Weight (UDW) = _____ kg

Rated Cargo/Luggage Weight (RCLW) = _____ kg

Weight of 2 p.572 Dummies @ 76 each = _____ kg

TARGET TEST WEIGHT = _____ kg

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES & KG OF CARGO WEIGHT:

Right Front = _____ kg Right Rear = _____ kg

Left Front = _____ kg Left Rear = _____ kg

TOTAL FRONT = _____ kg TOTAL REAR = _____ kg

TOTAL TEST WEIGHT = _____ kg

% of Total Front Weight = _____ % % of Total Rear Weight = _____ %

Weight of Ballast Secured in Vehicle Trunk Area = _____ kg

Vehicle Components Removed for Weight Reduction: _____

VEHICLE ATTITUDE (all dimension in millimeters):

AS DELIVERED : RF _____ LF _____ RR _____ LR _____

FULLY LOADED : RF _____ LF _____ RR _____ LR _____

AS TESTED : RF _____ LF _____ RR _____ LR _____

Vehicle's Wheel Base : _____ mm

Location of Vehicle's C.G. : _____ mm rearward of front wheel center.

FUEL SYSTEM DATA :

Fuel System Capacity From Owner's Manual = _____ liters

Usable Capacity Figure Furnished by COTR = _____ liters

Test Volume Range (92 to 94% of Usable Capacity) = _____ to _____ liters

ACTUAL TEST VOLUME= _____ liters (with entire fuel system filled)

Test Fluid Type: _____; Spec. Grav. = _____

Kinematic Viscosity = _____ centistokes; Color = Orange

Type of Fuel Pump: Electric- ____; Mechanical- ____

Does Electric Pump operate with ignition switch "ON" & engine "OFF" Yes-____ No- ____

Details of Fuel System _____

15. DATA SHEETS ..... Continued

DATA SHEET NO. 3 POST IMPACT DATA

TYPE OF TEST:

Type of Test : _____ Impact Angle : _____

Test Date : _____ Time: _____ Temperature: _____ ºC

Vehicle NHTSA No. : _____

Required Impact Velocity Range : _____ to _____ kph

BARRIER IMPACT VELOCITY : (Speed traps within 5 feet of impact plane.)

Trap No. 1 = _____ kph; Trap No. 2 = _____ kph

Distance from vehicle to barrier : (1) entering trap = _____ mm

(2) exiting trap = _____ mm

VEHICLE STATIC CRUSH: (mm) (For frontal and rear impacts only.)

Vehicle Length:

Pre-Test Right = _____ ; C/L = _____ ; Left = _____

Post-Test Right = _____ ; C/L = _____ ; Left = _____

Crush Right = _____ ; C/L = _____ ; Left = _____

AVERAGE = _____ mm

VEHICLE REBOUND: (From rigid barrier only.)

Distance from front of test vehicle to impact point :

Right = _____ ; C/L = _____ ; Left = _____

AVERAGE = _____ mm

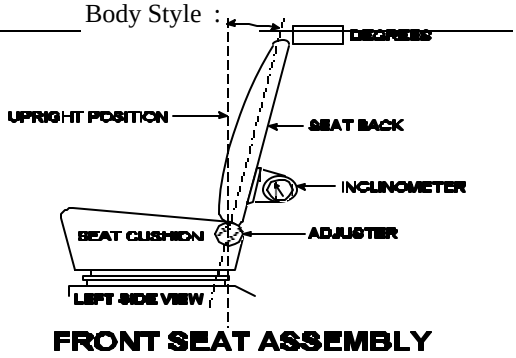
15. DATA SHEETS .....Continued

DATA SHEET NO. 4 TEST VEHICLE INFORMATION

VEHICLE IDENTIFICATION:

Model Year : _____ Vehicle Model: _____ Body Style : _____

1. **Nominal Design Riding Position** for adjustable driver and passenger seat backs. Please describe how to position the inclinometer to measure the seat back angle. Include description of the location of the adjustment latch detent, if applicable.



FRONT SEAT ASSEMBLY

Seat back angle for driver's seat: _____

Measurement instructions: _____

_____

_____

Seat back angle for passenger's seat: _____

Measurement instructions: _____

_____

2. **Seat Fore and Aft Positioning**

Positioning of the driver's seat: _____

_____

Positioning of the passenger's seat: _____

_____

3. **Fuel Tank Capacity Data**

3.1 A. "Usable Capacity" of the standard equipment fuel tank is _____ liters

B. "Usable Capacity" of the optional equipment fuel tank is _____ liters

C. "Usable Capacity" of the vehicle(s) used for certification testing to requirements of FMVSS 301 = _____ liters

3.2 Amount of Stoddard solvent added to vehicle(s) used for certification test(s) = _____ liters

3.3 Is vehicle equipped with electric fuel pump? Yes- ____ ; No- ____

If YES, explain the vehicle operating conditions under which the fuel pump will pump fuel.

_____

_____

4. **STEERING COLUMN ADJUSTMENTS :**

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions. If the tested vehicle has any of these adjustments, does your company use any specific procedures to determine the geometric center.

Operational Instructions: _____

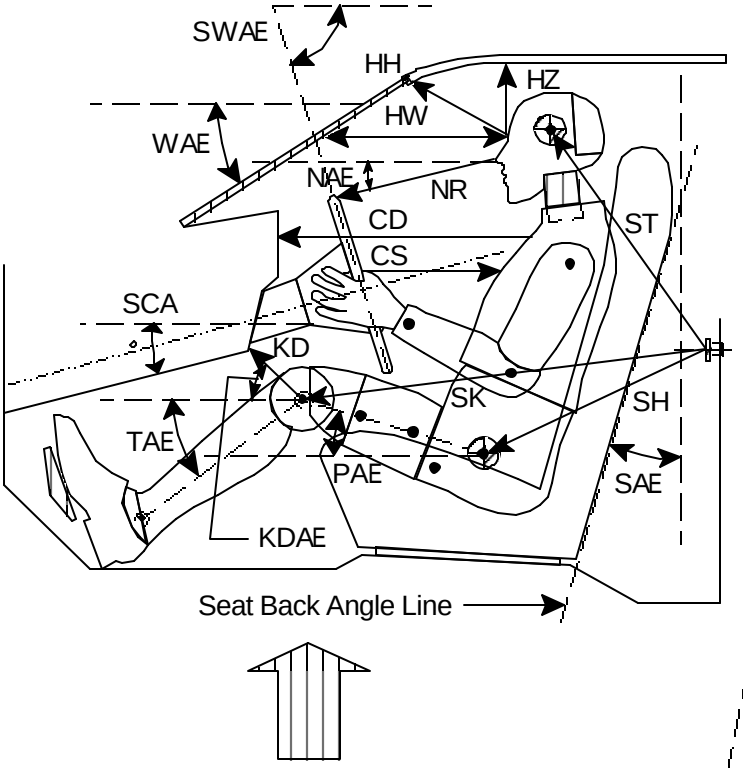
_____

5. SEAT BELT UPPER ANCHORAGE

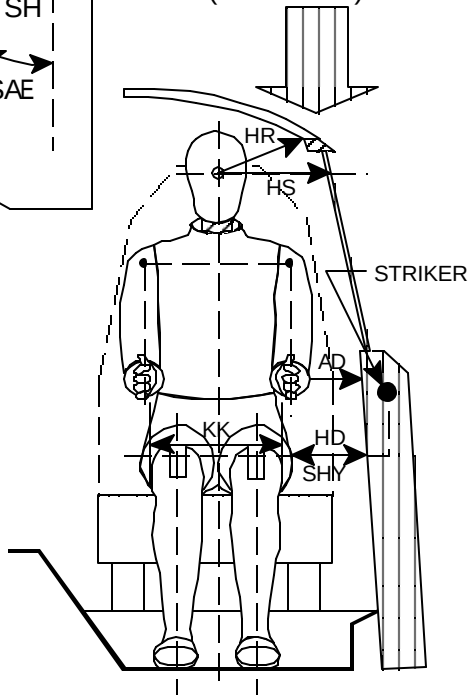
Nominal design riding position: _____

_____

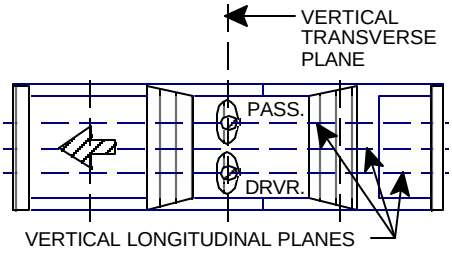
DUMMY MEASUREMENT FOR FRONT SEAT PASSENGERS



AD - Arm to Door
HD - H-Point to Door
HR - Head to Side Header
HS - Head to Side Window
KK - Knee to Knee
SHY- Striker to H-Point (Y Direction)



CD - Chest to Dash
CS - Steering Wheel to Chest
HH - Head to Header
HW - Head to Windshield
HZ - Head to Roof
KDA - Knee to Dash Angle
KDL- Left Knee to Dash
KDR - Right Knee to Dash
NA - Nose to Rim Angle
NR - Nose to Rim
PA - Pelvic Angle
RA - Rim to Abdomen
SA - Seat Back Angle
SCA - Steering Column Angle
SH - Striker to H-Point
SK - Striker to Knee
ST - Striker to Head
SWA- Steering Wheel Angle
TA - Tibial Angle
WA - Windshield Angle



15. DATA SHEETS .....Continued

DATA SHEET NO. 5 FRONT SEAT DUMMY POSITIONING MEASUREMENTS IN VEHICLE

	DRIVER (Serial #)	PASS. (Serial #)
WA^{O}		
SWA^{O}		
SCA^{O}		
SA^{O}		
HZ		
HH		
HW		
HR		
NR	Angle	
CD		
CS		
RA		
KDL	Angle (KDA) deg.	
KDR		Angle (KDA) deg.
PA^{O}	deg.	deg.
TA^{O}	deg.	deg.
KK		
ST	Angle deg.	Angle deg.
SK	Angle deg.	Angle deg.
SH	Angle deg.	Angle deg.
SHY		
HS		
HD		
AD		

Dimensions in millimeters

15. DATA SHEETS .... Continued

DESCRIPTIONS OF DUMMY MEASUREMENTS

When a level is to be used, it is to ensure that the line containing the two points described is either parallel or perpendicular to the ground. If a measurement to be made is less than 10 inches ignore the directions to use a level and approximate a level measurement. Also, when a measurement is to be taken to or from the center of a bolt on the dummy, take the measurement from the center of the bolt hole if the bolt is recessed.

The following measurements are to be made within a vertical longitudinal plane.

* HH Head to Header, taken from the point where the dummy's nose meets his forehead (between his eyes) to the furthest point forward on the header.

* HW Head to Windshield, taken from the point where the dummy's nose meets his forehead (between his eyes) to a point on the windshield. Use a level.

HZ Head to Roof, taken from the point where the dummy's nose meets his forehead (between his eyes) to the point on the roof directly above it. Use a level.

* CS Steering Wheel to Chest, taken from the center of the steering wheel hub to the dummy's chest. Use a level.

* CD Chest to Dash, place a tape measure on the tip of the dummy's chin and rotate five inches of it downward toward the dummy to the point of contact on the transverse center of the dummy's chest. Then measure from this point to the closest point on the dashboard either between the upper part of the steering wheel between the hub and the rim, or measure to the dashboard placing the tape measure above the rim, whichever is a shorter measurement. See photograph.

RA Steering Wheel Rim to Abdomen, taken from the bottommost point of the steering wheel rim horizontally rearward to the dummy. Use a level.

NR Nose to Rim, taken from the tip of the dummy's nose to the closest point on the top of the steering wheel rim. Also indicate the angle this line makes with respect to the horizontal (NA).

*[1] KDL, KDR Left and Right Knees to Dashboard, taken from the center of the knee pivot bolt's outer surface to the closest point forward acquired by swinging the tape measure in continually larger arcs until it contacts the dashboard. Also reference the angle of this measurement with respect to the horizontal for the outboard knee (KDA). See photograph.

* Measurement used in Data Tape Reference Guide

[1] Only outboard measurement is referenced in Data Tape Reference Guide

15. DATA SHEETS .... Continued

SH, SK, ST Striker to Hip, Knee, and Head, these measurements are to betaken in the X-Z plane measured from the forward most center point on the striker to the center of the H-point, outer knee bolt, and head target. When taking this measurement a firm device that can be rigidly connected to the striker should be used. Use a level. The angles of these measurements with respect to the horizontal should also be recorded. The measurement in the Y (transverse) direction from the striker to the H-point should also be taken (SHY). See photograph.

The following measurements are to be made within a vertical transverse plane.

HS Head to Side Window, taken from the point where the dummy's nose meets his forehead (between his eyes) to the outside of the side window. In order to make this measurement, roll the window down to the exact height which allows a level measurement. Use a level. See photograph.

* AD Arm to Door, taken from the outer surface of the elbow pivot bolt on a Hybrid 11 dummy to the first point it hits on the door. In the case of a Hybrid III dummy, measure from the bolt on the outer biceps. When a SID is used make the measurement from the center of the bottom of the arm segment where it meets the dummy's torso.

* HD H-point to Door, taken from the H-point on the dummy to the closest point on the door. Use a level.

* HR Head to Side Header, measure the shortest distance from the point where the dummy's nose meets his forehead (between his eyes) to the side edge of the header just above the window frame, directly adjacent to the dummy.

SHY Striker to H-point, taken from a rod rigidly connected to the forward most center point on the striker to the H-point. Use a level. See photograph.

KK Knee to Knee, for Hybrid 11 dummies measure the distance between knee pivot bolt head outer surfaces. For Hybrid III dummies measure the distance between the outboard knee clevis flange surfaces. (This measurement may not be exactly transverse)

* Measurement used in Data Tape Reference Guide

Angles

SA Seat Back Angle, find this angle using the instructions provided by the manufacturer. If the manufacturer doesn't provide clear instructions contact the COTR.

PA Pelvic or Femur Angle, taken by inserting the pelvic angle gauge into the H-point gauging hole on the SID or the Hybrid III dummies and taking this angle with respect to the horizontal.

Measure the angle of the line connecting the H-point hole and the outer knee pivot bolt hole on a Hybrid 11 dummy with respect to the horizontal, to find the femur angle.

15. DATA SHEETS .... Continued

SWA Steering Wheel Angle, find this by placing a straight edge against the steering wheel rim along the longitudinal plane. Then measure the acute angle of the straight edge with respect to the horizontal.

SCA Steering Column Angle, measured with respect to the horizontal by placing an inclinometer on the center of the underside of the steering column.

NA Measure the angle made when taking the measurement NR with respect to the horizontal.

KDA Knee to Dash Angle, the angle that the measurement KD is taken at with respect to the horizontal. Only get this angle for the outboard knee. See photograph.

WA Windshield Angle, place an inclinometer along the transverse center of the windshield exterior (measurement is made with respect to horizontal).

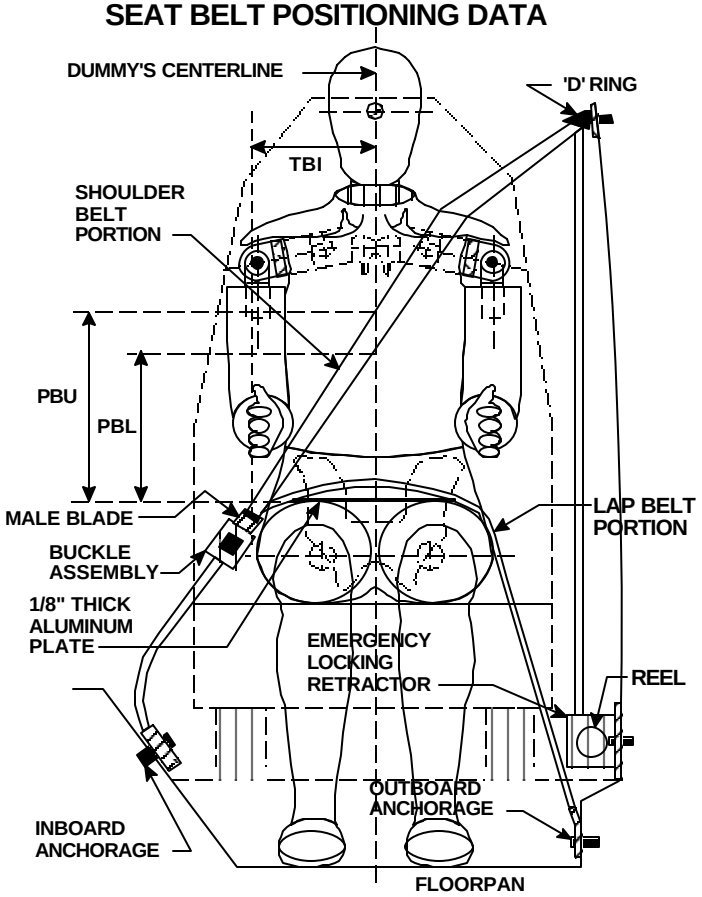
TA Tibial Angle, use a straight edge to connect the dummy's knee and ankle bolts. Then place an inclinometer on the straightedge and measure the angle with respect to the horizontal.

DUMMY MEASUREMENT PHOTOS

15. DATA SHEETS .... Continued

DATA SHEET NO. 6 SEAT BELT POSITIONING DATA

SEAT BELT POSITIONING DATA

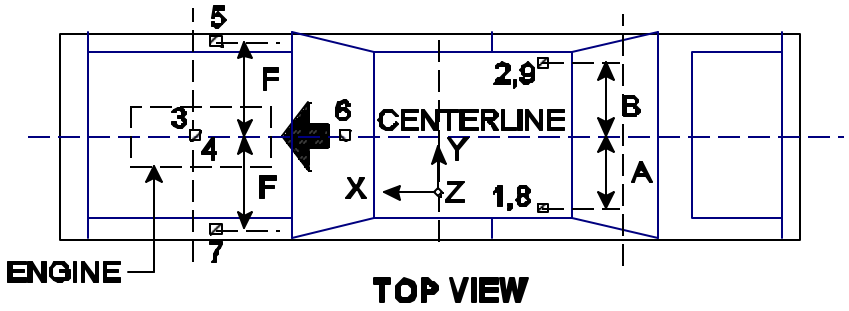


FRONT VIEW OF DUMMY

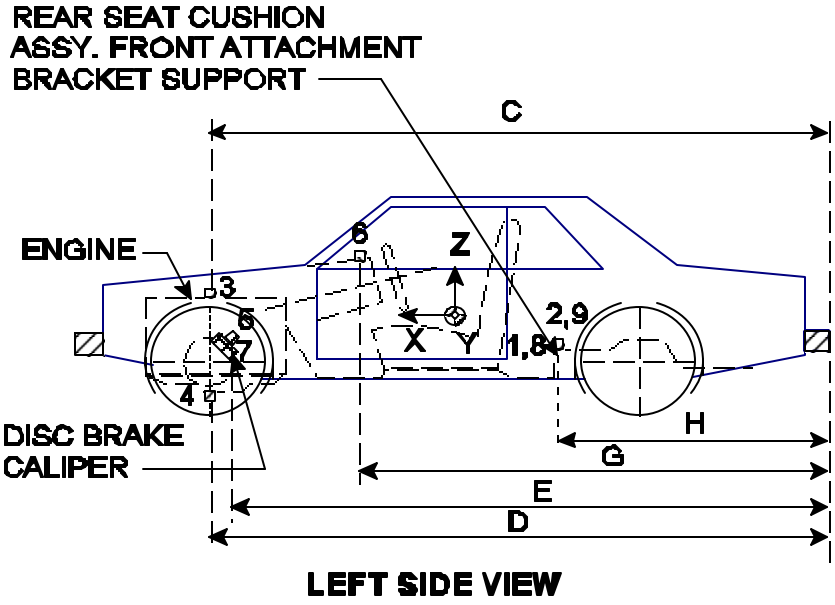
	DRIVER DUMMY (mm)	PASSENGER DUMMY (mm)
PBU -- Top surface of alum. plate to upper edge		
PBL-- Top surface of alum. plate to belt lower edge		
LAP BELT TENSION		
SHOULDER BELT TENSION		

15. DATA SHEETS .... Continued

VEHICLE ACCELEROMETER LOCATION AND DATA SUMMARY



TOP VIEW



LEFT SIDE VIEW

Note: Vehicle accelerometer location and data summary shown in DATA SHEET NO. 7

15. DATA SHEETS .... Continued

DATA SHEET NO. 7 VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

DIMENSION	LENGTH (mm)
	PRE-TEST VALUES
A Left Rear Seat Crossmember Y	
B Right Rear Seat Crossmember Y	
C Top of Engine X	
D Bottom of Engine X	
E Disc Brake Calipers X	
F Disc Brake Calipers Y	
G Instrument Panel X	
H Rear Seat Crossmembers X	

LOCATION NUMBER	DESCRIPTION	MAXIMUM VALUE (g's)			
		Pos.	msec.	Neg.	msec.
1	Rear Seat X-Member @ Left Side				
2	Rear Seat X-Member @ Right Side				
3	Top of Engine Block				
4	Bottom of Engine				
5	Disc Brake Caliper @ Right Side				
6	Instrument Panel				
7	Disc Brake Caliper @Left Side				
8	Rear Seat X-Member @ Left-Redundant				
9	Rear Seat X-Member @ Right-Redundant				

15. DATA SHEETS .... Continued

DATA SHEET NO. 8 DUMMY INJURY CRITERIA VALUES

Vehicle Year/Make/Model/Body Style: _____

NHTSA Test No.: _____ Test Date: _____

		MAXIMUM VALE							
		Driver				Passenger			
DESCRIPTION	**Unit**	**Pos**	**msec**	**Neg**	**msec**	**Pos**	**msec**	**Neg**	**msec**
Head X	**g**								
Head Y	**g**								
Head Z	**g**								
Head Resultant	**g**								
Redundant Head X	**g**								
Redundant Head Y	**g**								
Redundant Head Z	**g**								
Redundant Head Resultant	**g**								
Upper Neck Fx	**N**								
Upper Neck Fy	**N**								
Upper Neck Fz	**N**								
Upper Neck F Resultant	**N**								
Upper Neck Mx	**N-m**								
Upper Neck My	**N-m**								
Upper Neck Mz	**N-m**								
Upper Neck M Resultant	**N-m**								
Chest X	**g**								
Chest Y	**g**								
Chest Z	**g**								
Chest Resultant	**g**								
Redundant Chest X	**g**								
Redundant Chest Y	**g**								
Redundant Chest Z	**g**								
Redundant Chest Resultant	**g**								
Chest Displacement	**mm**								

15. DATA SHEETS .... Continued

DATA SHEET NO. 8 DUMMY INJURY CRITERIA VALUES (cont.)

Vehicle Year/Make/Model/Body Style: _____

NHTSA Test No.: _____ Test Date: _____

		MAXIMUM VALE							
		Driver				Passenger			
DESCRIPTION	**Unit**	**Pos**	**msec**	**Neg**	**msec**	**Pos**	**msec**	**Neg**	**msec**
Pelvic X	**g**								
Pelvic Y	**g**								
Pelvic Z	**g**								
Pelvic Resultant	**g**								
Left Femur	**N**								
Right Femur	**N**								
Left Upper Tibia Mx	**N-m**								
Left Upper Tibia My	**N-m**								
Left Lower Tibia Fz	**N**								
Left Lower Tibia Mx	**N-m**								
Left Lower Tibia My	**N-m**								
Right Upper Tibia Mx	**N-m**								
Right Upper Tibia My	**N-m**								
Right Lower Tibia Fz	**N**								
Right Lower Tibia Mx	**N-m**								
Right Lower Tibia My	**N-m**								
Left Foot Aft Ax	**g**								
Left Foot Aft Az	**g**								
Left Foot Fore Az	**g**								
Right Foot Aft Ax	**g**								
Right Foot Aft Az	**g**								
Right Foot Fore Az	**g**								
Lap Belt Load	**N**								
Torso Belt	**N**								

15. DATA SHEETS .... Continued

DATA SHEET NO. 8 DUMMY INJURY CRITERIA VALUES (cont.)

Vehicle Year/Make/Model/Body Style: _____

NHTSA Test No.: _____ Test Date: _____

	HEAD INJURY CRITERIA (HIC)			
	HIC**	t_1 (msec)	t_2 (msec)	Average Acceleration t_1 to t_2
Position #1 - Driver				
Position #2 - Passenger				

** HIC is as defined in FMVSS 208. The maximum time interval from t_1 to t_2 is 36 milliseconds.

	CLIP SUMMARY*			
	CLIP (g's)	t_1 (msec)	t_2 (msec)	CSI
Position #1 - Driver				
Position #2 - Passenger				

* The maximum chest resultant acceleration is defined as the maximum acceleration which exceeds 0.003 seconds in duration.

15. DATA SHEETS .... Continued

DATA SHEET NO. 8 DUMMY INJURY CRITERIA VALUES (cont.)
REDUNDANT DATA

Vehicle Year/Make/Model/Body Style: _____

NHTSA Test No.: _____ Test Date: _____

	HEAD INJURY CRITERIA (HIC) **REDUNDANT**			
	HIC**	t_1 (msec)	t_2 (msec)	Average Acceleration t_1 to t_2
Position #1 - Driver				
Position #2 - Passenger				

** HIC is as defined in FMVSS 208. The maximum time interval from t_1 to t_2 is 36 milliseconds.

	CLIP SUMMARY* **REDUNDANT**			
	CLIP (g's)	t_1 (msec)	t_2 (msec)	CSI
Position #1 - Driver				
Position #2 - Passenger				

* The maximum chest resultant acceleration is defined as the maximum acceleration which exceeds 0.003 seconds in duration.

15. DATA SHEETS .... Continued

DATA SHEET NO. 9 SEAT BELT PERFORMANCE ASSESSMENT TEST DATA

BELT LENGTH DATA:	Driver	Passenger
Belt length from trim panel exit to bolt hole anchor point for continuous webbing systems.		
Shoulder belt length as measured on Part 572 Dummy.		
Lap belt length as measured on Part 572 Dummy.		
SHOULDER BELT SPOOL-OFF DATA:		
As determined by film analysis.		
As determined mechanically.		
As determined electronically.		
BELT STRETCH DATA:		
Measured electronically between shoulder belt load cell and the "D" ring.		
Measured mechanically.		

_____
Dimensions in millimeters

† Safety belt trim exit was located at the upper D-ring. The was no available mounting location for the mechanical or electronic spool-off measurement.

15. DATA SHEETS .... Continued

DATA SHEET NO.10 SUMMARY OF FMVSS 212 DATA

FMVSS NO. 212 - "WINDSHIELD MOUNTING" DATA

DETAILS OF WINDSHIELD MOUNTING SUCH AS RETENTION METHOD, TRIM TYPE, ETC.:

FMVSS 212 REQUIREMENTS:

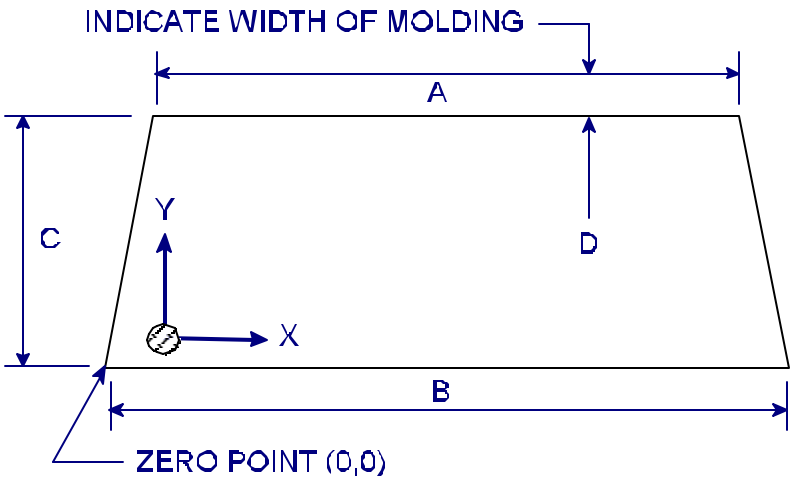
The Post-Test periphery retention amount must be at least 75% of the Pre-Test periphery measurement for vehicles NOT equipped with automatic restraints, and 50% for each side of the windshield for vehicles equipped with automatic restraint systems for front occupants,

FMVSS 212 TEST DATA

	WINDSHIELD PERIPHERY		
	PRE-TEST (mm)	POST-TEST(mm)	% OF RETENTION
RIGHT SIDE			
LEFT SIDE			
TOTAL			

AREA OF RETENTION FAILURE:

DIMENSIONS (mm)	
A	
B	
C	
D	



FRONT VIEW OF WINDSHIELD

FAILURE DETAILS: None

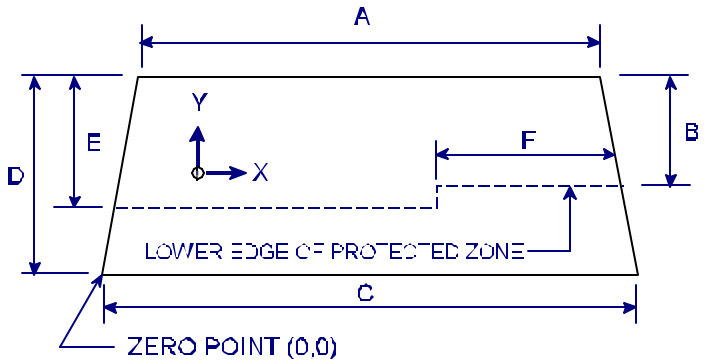
15. DATA SHEETS .... Continued

DATA SHEET NO. 11 FMVSS NO. 219 (PARTIAL) - "WINDSHIELD ZONE INTRUSION" DATA

PROTECTED ZONE LOWER EDGE REQUIREMENT:

The lower edge of the protected zone is determined by placing a 165 mm diameter rigid sphere weighing 6.8 kg in a position such that it simultaneously contacts the inner surface of the windshield and the top surface of the instrument panel including padding. The locus of points is drawn on the inner surface of the windshield contacted by the sphere across the width of the instrument panel. From the outermost contactable points extend the locus line horizontally to the edges of the windshield, then draw a line on the inner surface of the windshield below and 13 mm distant from the locus line. The LOWER EDGE OF THE PROTECTED ZONE is the longitudinal projection of this line onto the outer surface of the windshield.

FMVSS 219 TEST DATA:
(Dimensions in mm)



FRONT VIEW OF WINDSHIELD

DIMENSIONS	
A	
B	
C	
D	
E	
F	

DETAILS OF WINDSHIELD GLASS PENETRATION GREATER THAN 6 mm: None

(Show location of penetration on the above sketch)

	COORDINATES	
	X	Y
1.		
2.		
3.		
4.		

15. DATA SHEETS .... Continued

DATA SHEET NO. 12 FMVSS NO. 301-75 "FUEL SYSTEM INTEGRITY" POST IMPACT TEST DATA

NHTSA TEST No.: ____________________ TEST DATE: ____________________

VEHICLE MAKE/MODEL: ____

The test vehicle was filled from 92% to 94% of the manufacture's "usable" capacity. The electric fuel pump was operating if it will operate without engine operation. Two Part 572 anthropomorphic test devices were located at each of the front designated seating positions.

= =

TEST VEHICLE IMPACT TYPE:

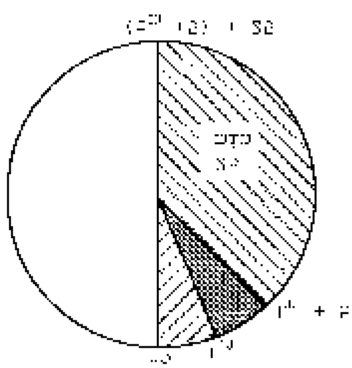
_____________ Frontal (56 kph)

_____________ Oblique (48 kph) with _________ deg. barrier face first contacting ________________________________ (driver/passenger) side

_____________ Rear Moving Barrier (48 kph)

_____________ Lateral Moving Barrier (32 kph)

FUEL SPILLAGE MEASUREMENT:



	ACTUAL	MAX ALLOWED
1. From impact until vehicle motion ceases		28 g
2. For 5 minute period after vehicle motion ceases		141 g
3. For next 25 minutes		28 g/min.

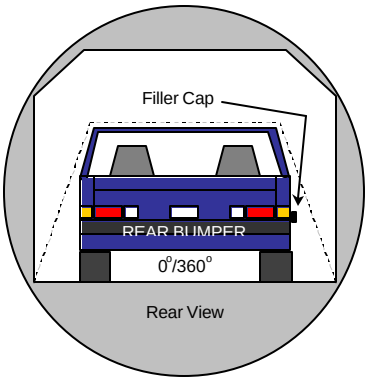
SOLVENT SPILLAGE DETAILS:

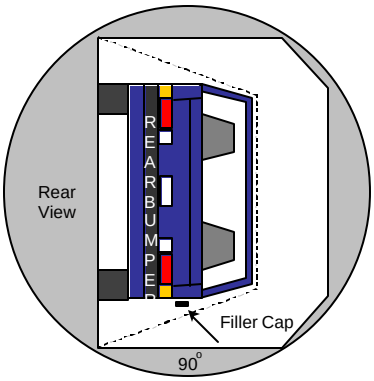
DATA SHEET NO. 13

FMVSS 301 STATIC ROLLOVER DATA SHEET

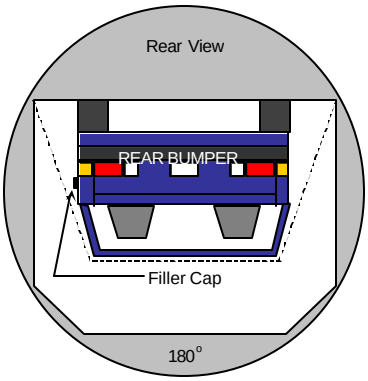
Test Vehicle: _____ NHTSA No.: _____

Test Program: _____ Test Date:_____

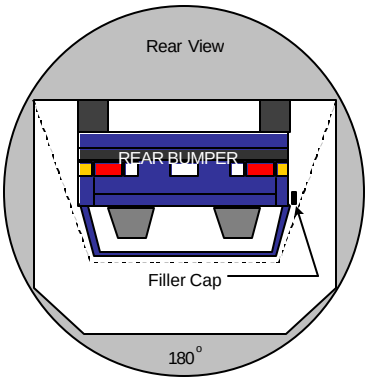




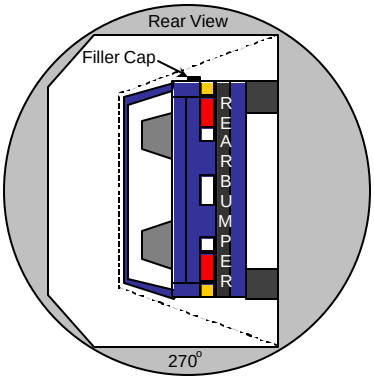
0° TO 90°

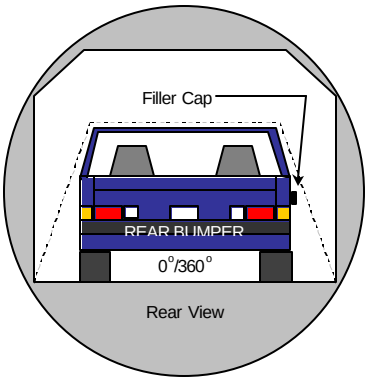


90°TO 180°



180° TO 270°

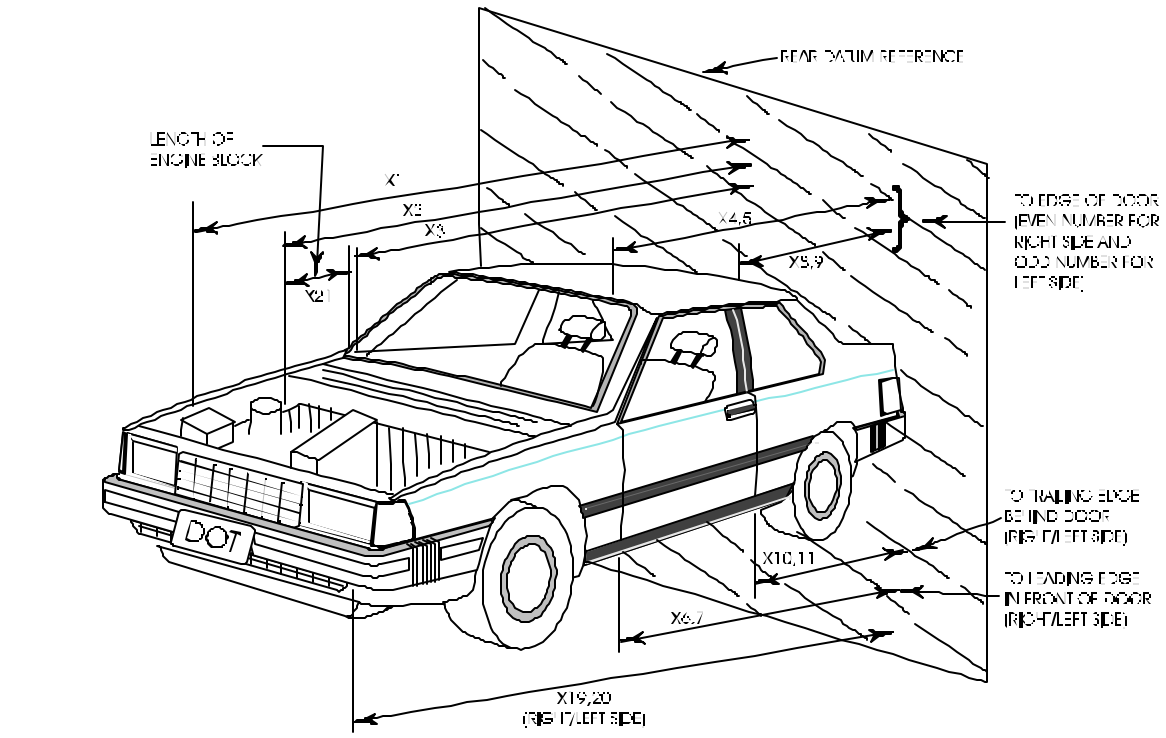


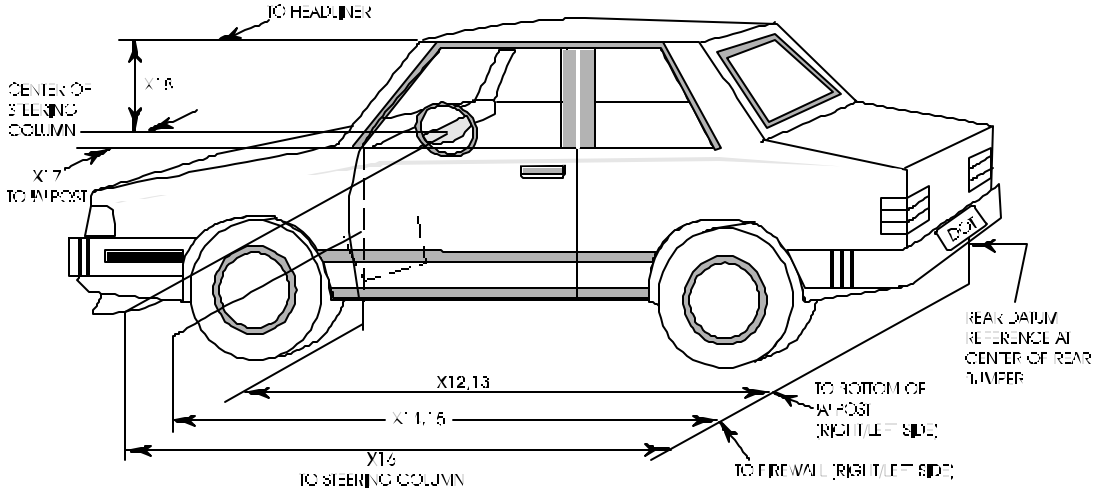


270°TO 360°

15.The specified fixture rollover rate for each 90° of rotation is 60 to 120 seconds.
16.The position hold time at each position is 300 seconds (minimum).
17.Details of Stoddard Solvent spillage locations:

TEST VEHICLE MEASUREMENTS





TEST PHASE	Rotation Time (sec.)	Hold Time (sec.)	Spillage (oz.)
0° TO 90°			
90° TO 180°			
180° TO 270°			
270° TO 360°			

DATA SHEET NO.14 VEHICLE MEASUREMENTS

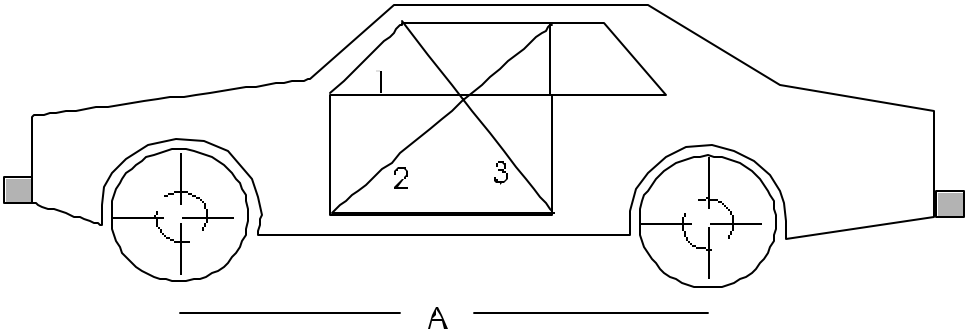
No.		Pre-Test	Post-Test	Differences
X1	Total Length of Vehicle at Centerline			
X2	Rear Surface of Vehicle to Front of Engine			
X3	Rear Surface of Vehicle to Firewall			
X4	Rear Surface of Vehicle to Upper Leading Edge of Right Door			
X5	Rear Surface of Vehicle to Upper Leading Edge of Left Door			
X6	Rear Surface of Vehicle to Lower Leading Edge of Right Door			
X7	Rear Surface of Vehicle to Lower Leading Edge of Left Door			
X8	Rear Surface of Vehicle to Upper Trailing Edge of Right Door			
X9	Rear Surface of Vehicle to Upper Trailing Edge of Left Door			
X10	Rear Surface of Vehicle to Lower Trailing Edge of Right Door			
X11	Rear Surface of Vehicle to Lower Trailing Edge of Left Door			
X12	Rear Surface of Vehicle to Bottom of "A" Post of Right Side			
X13	Rear Surface of Vehicle to Bottom of "A" Post of Left Side			
X14	Rear Surface of Vehicle to Firewall, Right Side			
X15	Rear Surface of Vehicle to Firewall, Left Side			
X16	Rear Surface of Vehicle to Steering Column			
X17	Center of Steering Column to "A" Post			
X18	Center of Steering Column to Headliner			
X19	Rear Surface of Vehicle to Right Side of Front Bumper			
X20	Rear Surface of Vehicle to Left Side of Front Bumper			
X21	Length of Engine Block			
RD	Rear Surface of Vehicle to Right Side of Dash Panel			
CD	Rear Surface of Vehicle to Center of Dash Panel			
LD	Rear Surface of Vehicle to Left Side of Dash Panel			

All Dimensions in mm

DATA SHEET NO.14 VEHICLE MEASUREMENTS (cont.)

VEHICLE INTRUSION MEASUREMENTS

DOOR OPENING WIDTH



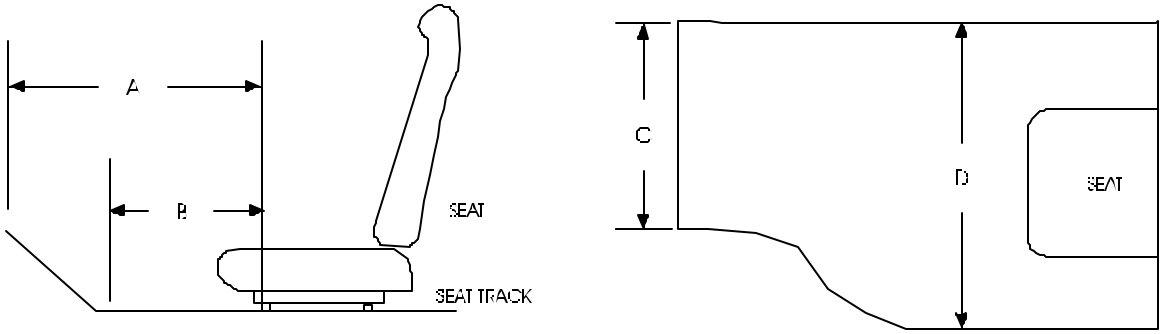
UNITS (mm)	LEFT			RIGHT		
MEASUREMENT	1	2	3	1	2	3
BEFORE TEST						
AFTER TEST						
DIFFERENCE						

UNITS (mm)	A = WHEELBASE LEFT	A = WHEELBASE RIGHT
BEFORE TEST		
AFTER TEST		
DIFFERENCE		

DATA SHEET NO.14 VEHICLE MEASUREMENTS (cont.)

VEHICLE INTRUSION MEASUREMENTS

STATIC FOOTWELL DEFORMATION



DRIVER

Measurement	Pre-Test	Post-Test	Difference
A			
B			
C			
D			

PASSENGER

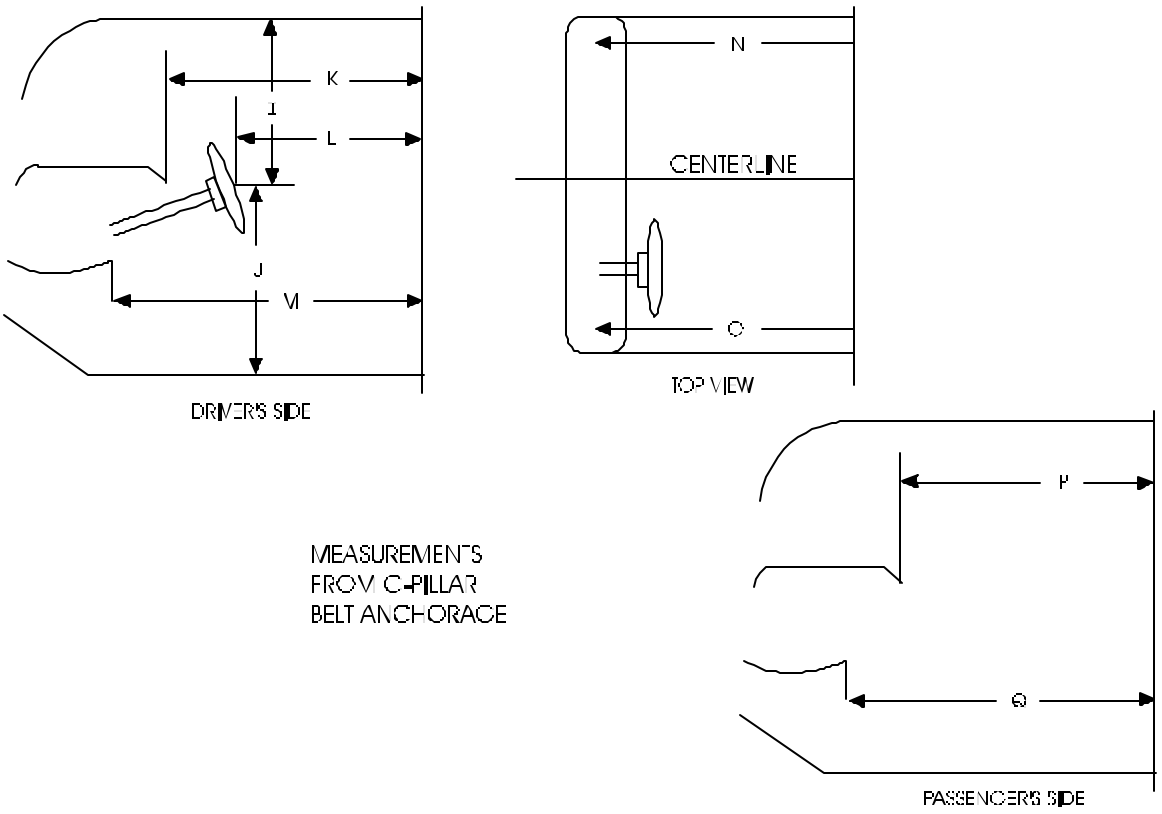
Measurement	Pre-Test	Post-Test	Difference
A			
B			
C			
D			

Units = mm

DATA SHEET NO.14 VEHICLE MEASUREMENTS (cont.)

VEHICLE INTRUSION MEASUREMENTS

STATIC PASSENGER COMPARTMENT INTRUSION

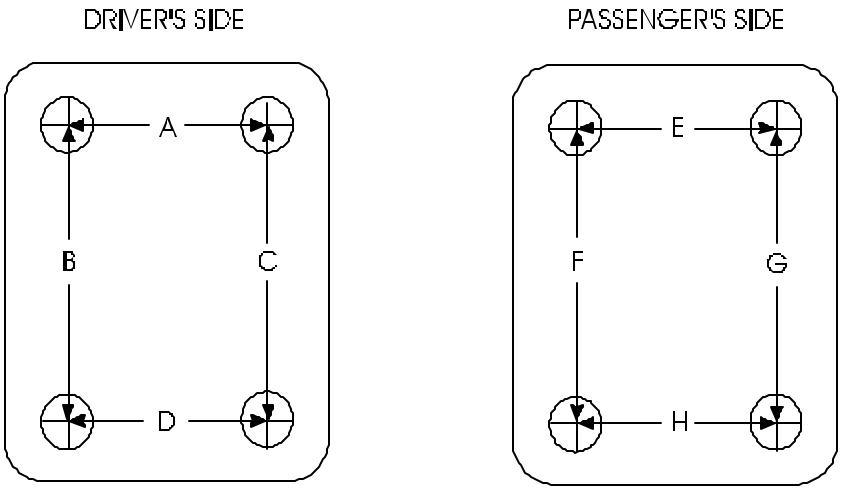


Measurement	Pre-Test	Post-Test	Difference
I			
J			
K			
L			
M			
N			
O			
P = K (PASS.)			
Q = M (PASS.)			

Units = mm

DATA SHEET NO.14 VEHICLE MEASUREMENTS (cont.)

FLOORBOARD DEFORMATION



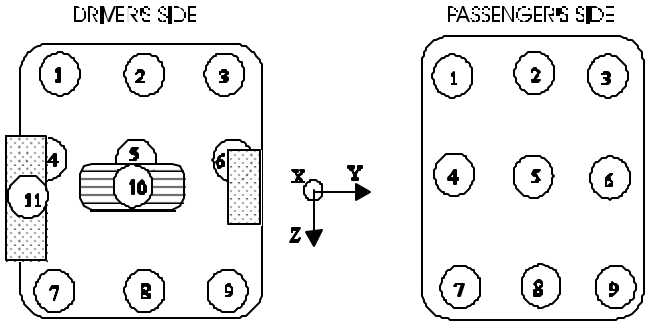
TOP VIEW THROUGH FLOOR PAN

Measurement	Pre-Test	Post-Test	Difference
A			
B			
C			
D			
E			
F			
G			
H			

Units = mm

DATA SHEET NO.14 VEHICLE MEASUREMENTS (cont.)

TOE-PAN INTRUSION



Driver Side Floorpan Measurements
Reference: X = Rear Bumper; Z = Ground

Floorpan	X Deformation			Z Deformation		
Location	Pre-Test	Post-Test	Difference	Pre-Test	Post-Test	Difference
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						

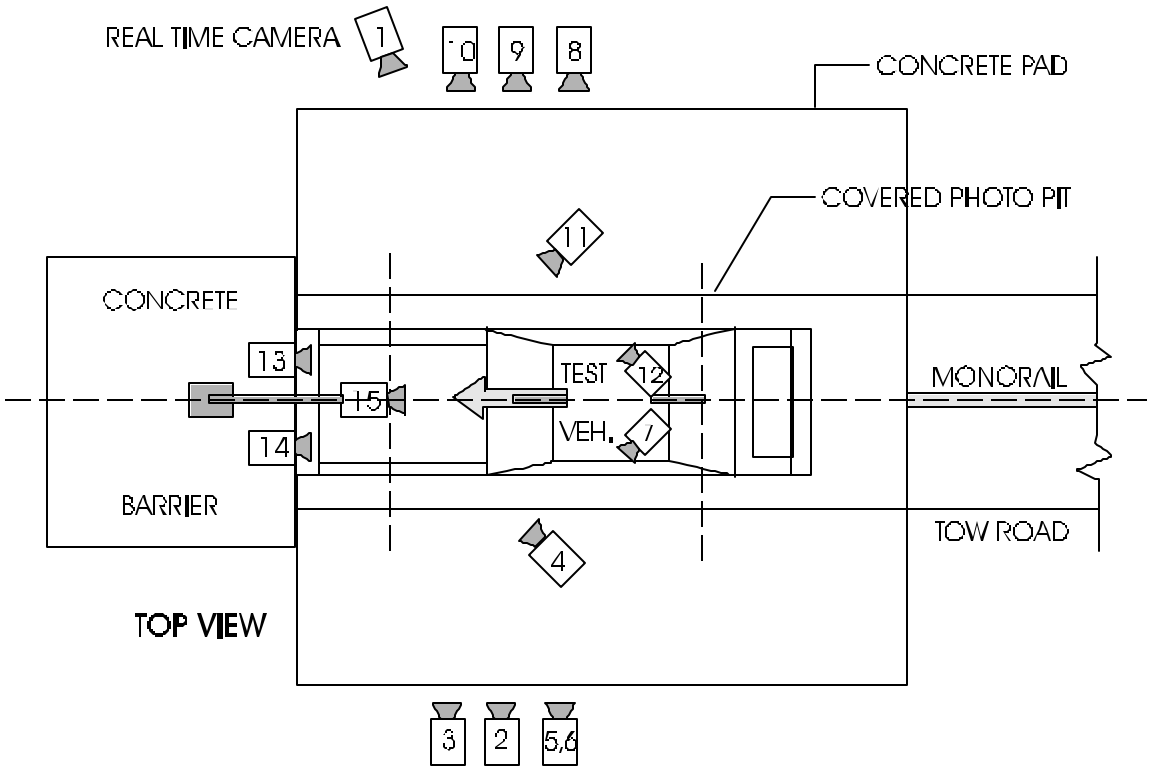
Passenger Side Floorpan Measurements
Reference: X = Rear Bumper; Z = Ground

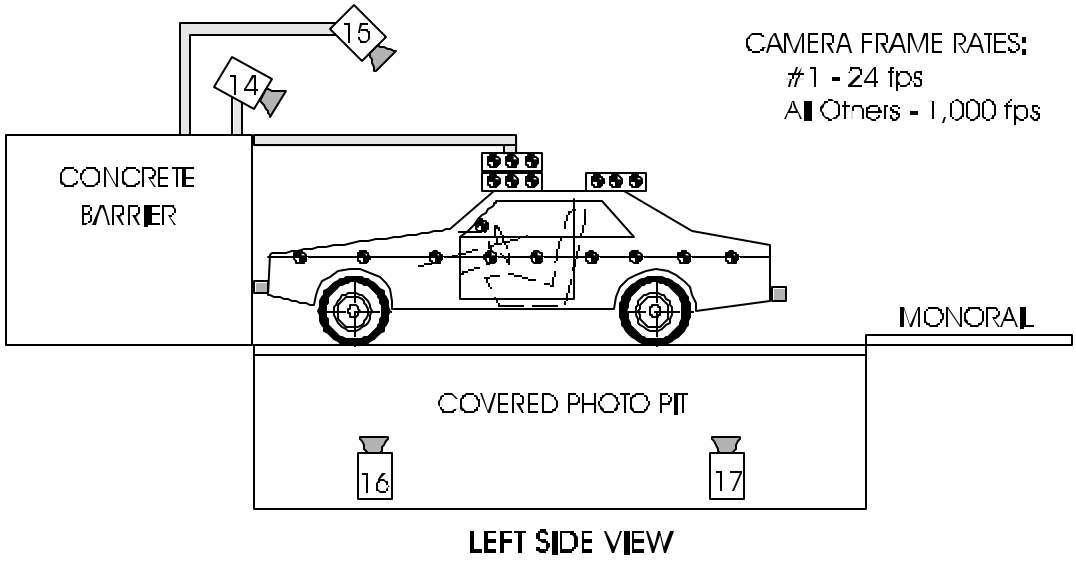
Floorpan	X Deformation			Z Deformation		
Location	Pre-Test	Post-Test	Difference	Pre-Test	Post-Test	Difference
1						
2						
3						
4						
5						
6						
7						
8						
9						

Units in mm

CAMERA POSITIONS FOR FRONTAL IMPACTS

NOTE: Camera information shown in DATA SHEET NO. 15.





DATA SHEET NO.15 HIGH-SPEED CAMERA LOCATIONS

NHTSA Test No.: _____ Vehicle: _____

CAMERA NO.	VIEW	CAMERA POSITIONS (mm)* X	Y	Z	ANGLE (deg)**	FILM PLANE TO HEAD TARGET	LENS (mm)	SPEED (fps)
1	Real-Time Camera							
2	Overall Left Side							
3	Left Side View							
4	Driver and Interior View							
5	Steering Column (Bottom)							
6	Steering Column (Top)							
7	Left Belt							
8	Overall Right Side							
9	Right Side View							
10	Right Passenger View							
11	Passenger and Interior View							
12	Right Belt							
13	Passenger Front View							
14	Driver Front View							
15	Windshield View							
16	Pit View of Engine							
17	Pit View of Fuel Tank							

*X = film plane to monorail centerline ** = referenced to horizontal plane

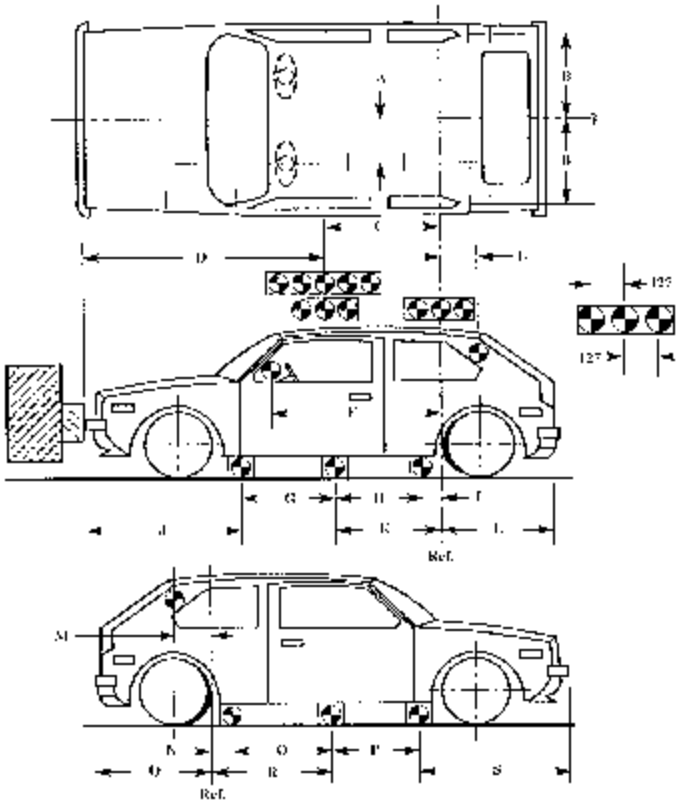
Y = film plane to impact location N.T. indicates No Timing

Z = film plane to ground

DATA SHEET NO. 16 VEHICLE REFERENCE PHOTO TARGET LOCATIONS

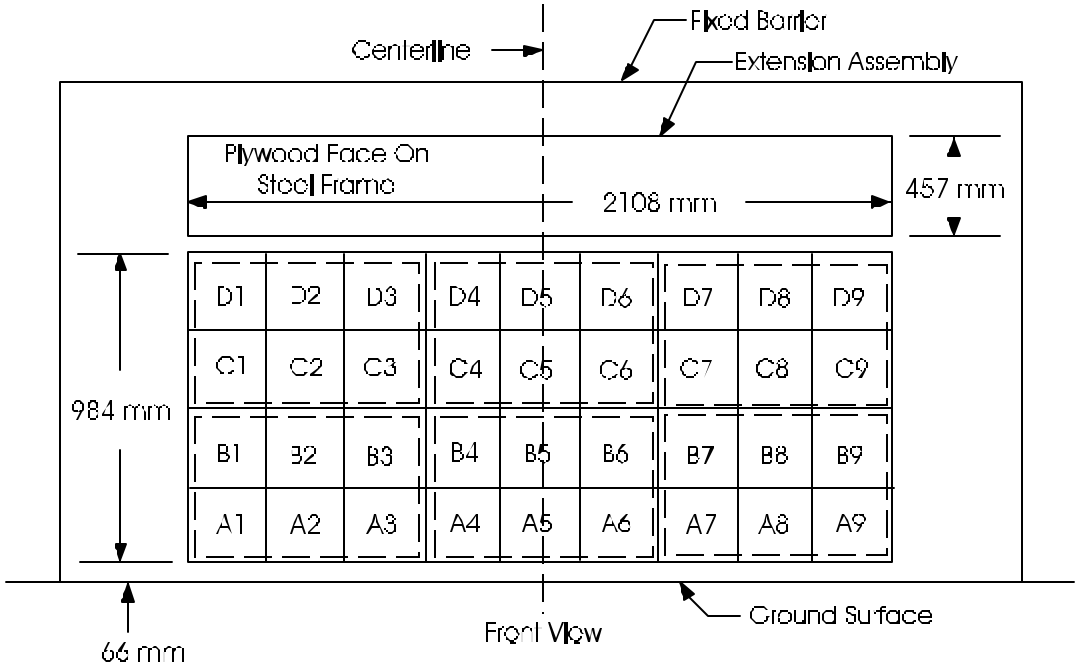
(Dimensions in millimeters)

A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	
M	
N	
O	
P	
Q	
R	
S	



DATA SHEET NO. 17 LOAD CELL LOCATIONS ON FIXED BARRIER

36 Load Cells
4 Rows
9 Columns
6 Groupings (6 cells/group)



6 GROUPS OF 6 LOAD CELLS EACH

Group 4 C1 thru D3	Group 5 C4 thru D6	Group 6 C7 thru D9
Group 1 A1 thru B3	Group 2 A4 thru B6	Group 3 A7 thru B9

The following data is presented in Appendix B:

(1)Data from 36 individual load cells
(2)Total or Sum of 36 individual load cells
(3)Data from 6 Groupings shown above (6 cells/group)

15. DATA SHEETS .... Continued

DATA SHEET NO. 18 POST TEST AIR BAG DATA

NHTSA No. : _____ Test Date: _____ Technician: _____

Vehicle Model Year/Make/Model: _____

A. No. of vent holes: _____-Driver _____-Passenger

B. Size of vent holes: (mm^2) _____-Driver _____-Passenger

C. Total vent area: (mm^2) _____-Driver _____-Passenger

D. Deflated air bag length and width dimensions or, if round, diameter. (mm)

Driver: _____-Length; _____-Width; _____-Diameter

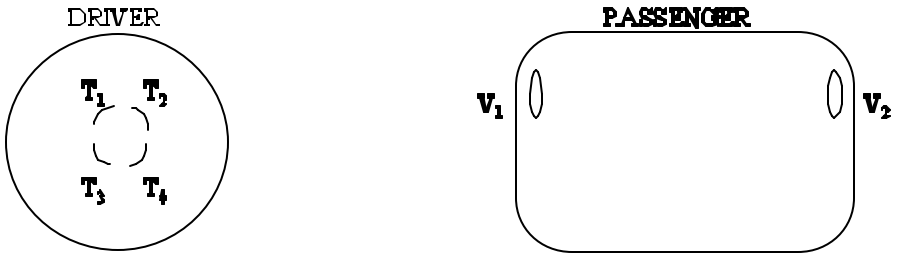
Passenger: _____-Height; _____-Width; _____-Depth

E. Is the air bag tethered?

Driver: _____-Yes; _____-No; If yes, record length of tether- _____

Passenger: _____-Yes; _____-No; If yes, record length of tether- _____

Sketch the air bag showing the location of the vent holes, how the bag is tethered, and where the bag is tethered. Also describe how the tethers are attached to the bag and the steering wheel.



(Note: Not to scale; V_n = Vent hole$_n$, T_n = Tether$_n$).

F. Record part numbers and manufacturer name of the air bag and gas generator.

Driver: _____

_____

Passenger: _____

_____

15. DATA SHEETS .... Continued

DATA SHEET NO. 19 ACCIDENT INVESTIGATION DIVISION DATA

Vehicle Make/Model/Body Style: _____

NHTSA Test No.: _____ VIN: _____

Model Year: _____ Build Date: _____ Test Date: _____

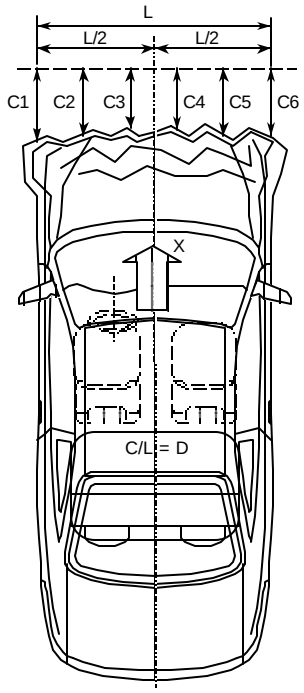
Vehicle Size Category: _____ Test Weight: _____ kg

Vehicle Wheelbase: _____ mm; Front Overhang: _____ mm; Overall Width: _____ mm

Collision Deformation Classification (CDC) Code: _____

Crush Depth Dimensions;

	PRE	POST	DIFF	
C1 =				mm
C2 =				mm
C3 =				mm
C4 =				mm
C5 =				mm
C6 =				mm



Midpoint of Damage: D = Vehicle Centerline (Longitudinal)

Length of Damaged Region:

L1= _____ mm

L2= _____ mm

L3= _____ mm

SECTION 3

PHOTOGRAPHS

SECTION 4

DUMMY, VEHICLE AND LOAD CELL BARRIER RESPONSE DATA TRACES

(filtered)

[Put in the same order as the Data Traces on the data tape]

SECTION 5

PART 572B/E DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA SHEETS

[Data sheets from Appendix A shall be used to document dummy calibration in the final test report]

SECTION 6

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

[Data sheets from Appendix A shall be used to document the
test equipment and instrumentation calibration - Temperature traces should be included]

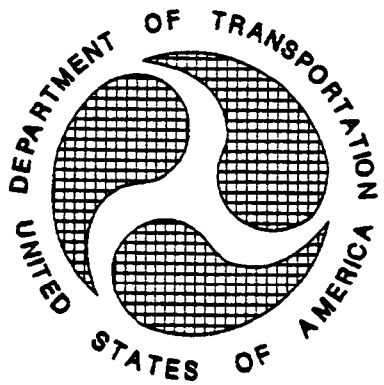
Note: This section should include the pre and post test zero and shunt calibration values as described in section 11.13 if applicable.

APPENDIX A

PART 572E DUMMY

PERFORMANCE CALIBRATION

TEST PROCEDURE



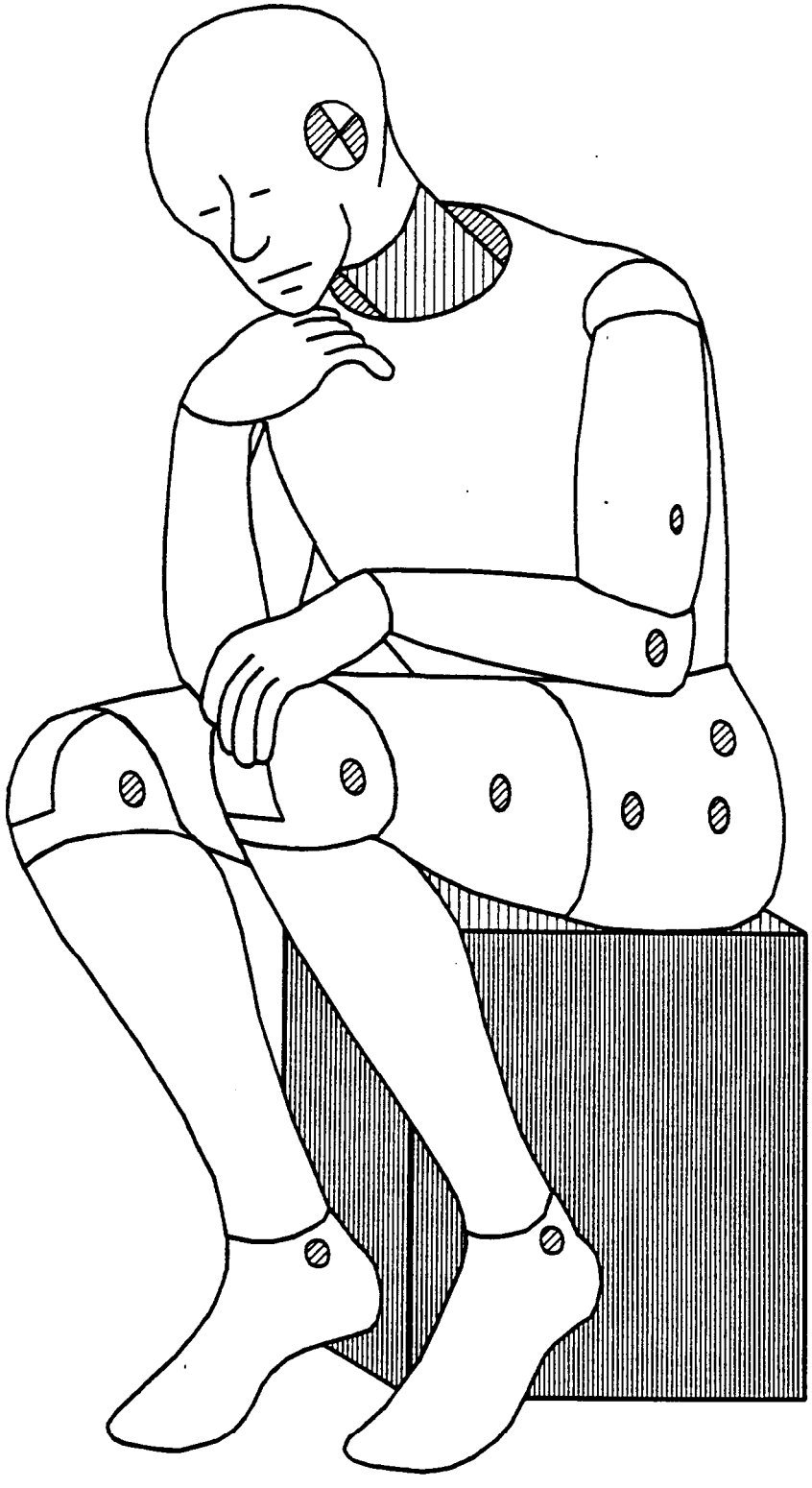
U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Safety Performance Standards
Office of Crashworthiness Standards
400 Seventh Street, SW
Washington, DC 20590

PART 572E DUMMY
PERFORMANCE CALIBRATION

TEST PROCEDURE



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APPENDIX AO

ILLUSTRATIONS

TABLES

1. PURPOSE AND APPLICATION

The purpose of this laboratory procedure is to provide dummy users (independent testing laboratories under contract with the Office of Crashworthiness Standards) with standard test procedures for performing receiving-inspection and performance calibration tests on the Part 572E dummy so that repetitive and correlative test results can be obtained. The following tests have been developed to establish a uniform calibration procedure for all users as the means of verifying the performance of the dummy.

A. EXTERNAL DIMENSIONS

B. HEAD DROP TEST

C. NECK FLEXION TEST

D. NECK EXTENSION TEST

E. THORAX IMPACT TEST

F. KNEE IMPACT TESTS

This laboratory procedure for the calibration of Part 572E dummies must be used by National Highway Traffic Safety Administration (NHTSA) contract laboratories performing NCAP testing for the Office of Crashworthiness Standards (OCS).

2. GENERAL REQUIREMENTS

The Code of Federal Regulations (49CFR), Parts 571 and 572, was amended to adopt the Hybrid **III, 50th** Percentile Dummy as an alternative to the Part 5728, 50th Percentile Dummy. Each Part 572E dummy used in an NCAP test must meet the specifications and performance criteria of Part 572.

The Part 572E Hybrid Ill 50th Percentile Dummy consists of components and assemblies specified in the drawing and specifications package which is available from Rowley-Sher Reprographics, Inc., 1216 K Street, N.W., Washington, D.C. 20005, phone - (202) 628-6667.

2. GENERAL REQUIREMENTS....Continued

PART 572E TEST DUMMY

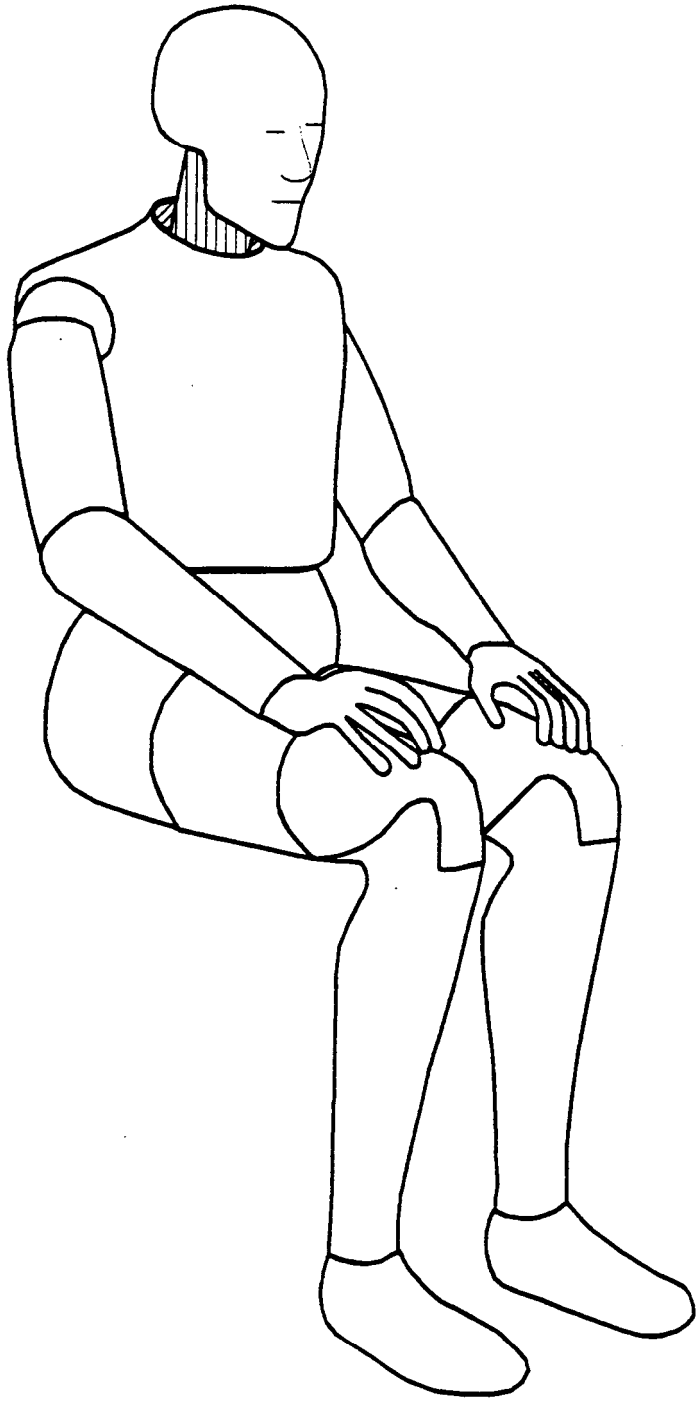


FIGURE 1A0

3. SECURITY

All NHTSA Part 572E test dummies delivered to the contract laboratory as Government Furnished Property (GFP) will be stored in a safe and secure area such as the dummy calibration laboratory. The contractor is financially responsible for any acts of theft and/or vandalism which occur during the storage of GFP. Any security problems shall be reported by telephone to the Industrial Property Manager (IPM), Office of Contracts and Procurement, within two working days after the incident. A letter containing specific details of the security problem will be sent to the IPM (with copy to the COTR) within 48 hours.

The contractor is responsible for maintaining the NHTSA test dummies in good working order, and shall protect and segregate the data that evolves from conducting Part 572E dummy calibration tests before and after each vehicle crash usage.

No Information concerning the Part 572E dummy calibration data shall be released to anyone except the COTR, unless specifically authorized by the COTR or the COTR's Branch or Division Chief.

No Individuals, other than contractor personnel directly involved in the dummy calibration test program, shall be allowed to witness dummy calibration tests unless specifically authorized by the COTR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the entire dummy calibration laboratory, 'test fixtures, and instrumentation in a neat, clean, and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The Part 572E dummies are being calibrated as test tools to be used in vehicle crash tests. The schedule for these performance calibration tests must be correlated with that of the vehicle barrier impact tests. All testing shall be coordinated to allow monitoring by the COTR.

6. TEST DATA DISPOSITION

The contractor shall make all dummy calibration data available to the COTR for review and analysis as required. All calibration test data for each particular Part 572E dummy will be sent to the COTR with each test report.

All backup data sheets, strip charts, recordings, plots, technicians notes, etc. shall be either sent to the COTR if requested, or destroyed at the conclusion of each delivery order, purchase order, etc.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

P572 test dummies will be furnished to the contract laboratory by the OCS. The dummies shall be stored in an upright sitting position with the weight supported by the internal structure of the pelvis. The dummies head shall be held upright without supporting the weight of the dummy by using an eye bolt that can be secured in the top of the head. These dummies shall be stored in a secured room which is kept between 55°F and 85°F. The contractor will check dummy components for damage after each crash test and complete a dummy damage checklist (NCAP procedure), that will be included with the dummy calibration, if requested. The COTR will be kept informed of the dummies condition in order that replacement parts can be provided. The dummies will be calibrated by the contractor according to the schedule indicated in the NCAP test procedure.

8. CALIBRATION AND TEST INSTRUMENTATION

Before the contractor initiates the dummy performance calibration test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices. Guidelines for setting up and maintaining such calibration systems are described in MIL-C-45662A, "Calibration System Requirements". The calibration system shall be set up and maintained as follows:

A. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 6 months for instruments and 12 months for calibration standards. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment.

C. All measuring and test equipment and measuring standards shall be labeled with the following information:

(1) Date of calibration

(2) Date of next scheduled calibration

(3) Name of the technician who calibrated the equipment

D. A written calibration procedure shall be provided by the contractor which includes, as a minimum, the following information for all measurement and test equipment:

(1) Type of equipment, manufacturer, model number, etc.

(2) Measurement range

(3) Accuracy

(4) Calibration interval

(5) Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident)

(6) The actual procedures and forms used to perform calibrations.

E. Records of calibrations for all test instrumentation shall be kept by the contractor in a manner that assures the maintenance of established calibration schedules. All such records shall be readily available for inspection when requested by the COTR. The calibration system will need the written acceptance of the COTR before testing begins.

F. Test equipment shall receive a calibration check immediately prior to and after each test. This check shall be recorded by the test technician(s) and submitted with the final report.

G. Anthropomorphic test devices shall be calibrated as indicated in NCAP test procedure. These calibrations shall be submitted with the final report.

9. PHOTOGRAPHIC DOCUMENTATION

Provide still photographs (8 x 10 inch glossy color prints properly focused for clear images) of post test calibration damage resulting from the vehicle crash test.

10. DEFINITIONS

NONE

11. PRETEST REQUIREMENTS

11.1 TRANSDUCER REQUIREMENTS

The contractor shall provide and install the following instrumentation to the GFP dummies (COTR should be consulted for specific sensor type to be used):

A. HEAD - - The primary head accelerometers shall have dimensions, response characteristics and sensitive mass locations specified in drawing 78051-l 36, revision A and be mounted in the head as shown in drawing 78051-61, revision T, and in the assembly shown in drawing 78051-218, revision R.

Three Endevco 7231 C-750 accelerometers with 1% Transverse Sensitivity or Endevco 7264's may be required in the head cavity to measure orthogonal accelerations (Ax, Ay, Az) at the center of gravity (CG) of the head assembly.

B. NECK - - The neck transducer shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing 83-5001-008 or C-l 709 and be mounted for testing as shown in drawing 79051-63, revision W, and in the assembly shown in drawing 78051-218, revision R.

C. CHEST - - The primary chest accelerometers shall have the dimensions, response characteristics, and sensitive mass locations specified in drawing 78051-l 36, revision A and be mounted as shown with adaptor assembly 78051-l 16, revision D for assembly into 78051-218, revision R. The chest accelerometers are not required for dummy calibration testing but are required for NCAP testing. Three Endevco 7231 C-750 accelerometers with 1% Transverse Sensitivity or Endevco 7264's may be required in the chest cavity to measure orthogonal accelerations (Ax, Ay, Az) at the CG of the chest assembly.

The chest deflection transducer shall have the dimensions and response characteristics specified in drawing 7805 l-342, revision A (Bourns Potentiometer Model 6638S-432-102, or alternate Vernitech Potentiometer Model 81422A) and be mounted in the chest deflection transducer assembly 78051-317, revision A for assembly into 7805 1-21 8, revision R.

D. LEGS - - The femur load cells shall have the dimensions, response characteristics, and sensitive axis locations specified in drawing 78051-265 (GSE Model 2430) and be mounted in assemblies 78051-46 and -47 for assembly into 78051-218, revision R. The femur transducers are not required for calibration of the dummy but are required for NCAP testing.

11. **PRETEST REQUIREMENTS.. . .Continued**

E. TEST FIXTURE - - The neck pendulum, thorax and knee probe accelerometers shall have the dimensions and characteristics of Endevco Model 7231 C.

F. The head and chest is to be instrumented with **redundant** accelerometers as described in the NCAP test procedure.

G. The dummies will be instrumented with **pelvic** and **foot accelerometers** and **lower leg** intrumentation as described in the **NCAP** test procedure.

The sign convention for outputs of transducers mounted within the Hybrid **III** are located in Figure 2A0 and Table **1A.**

The outputs of acceleration and force-sensing devices installed in the dummy and in the test apparatus specified by this part are recorded with individual data channels. Each data channel will be comprised of a sensor, signal conditioner, data acquisition device, and all interconnecting cables, and must conform to the requirements of SAE Recommended Practice J211, "Instrumentation for Impact Test," with channel classes as follows:

A. Head **acceleration/Neck** force/Pelvic Accel . . Class 1000
Foot **accels.**

B. Intentionally blank

C. Neck pendulum acceleration . . . . . Class 60

D. Neck rotation transducers . . . . . Class 60

E. Thorax and thorax pendulum acceleration . . . Class 180

F. Thorax deflection . . . . . Class 180

G. Knee pendulum acceleration . . . . . Class 600

H. Femur force . . . . . Class 600

All filter classes should be of the "phaseless" type to be compatible with the "time" dependent test parameters.

SIGN CONVENTIONS FOR PART 572 SUBPART B AND E TEST DUMMIES

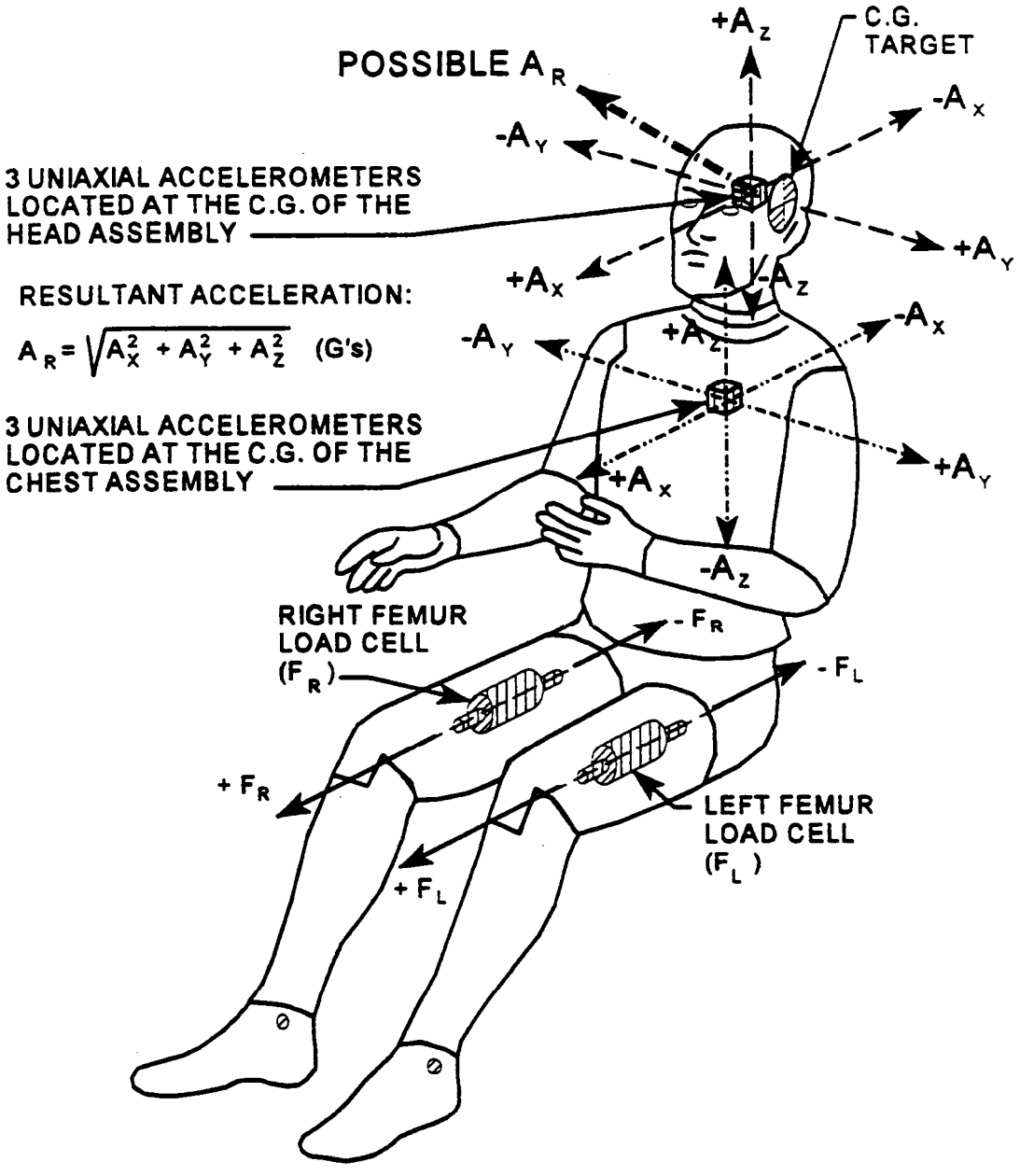


FIGURE 2AO

TABLE 1AO

SIGN CONVENTION FOR HYBRID III TRANSDUCER OUTPUTS	
BODY SEGMENT-- MEASURED FORCE	**POSITIVE OUTPUT DIRECTION**
NECK	
FX SHEAR	CHEST REARWARD OR HEAD FORWARD
FY SHEAR	CHEST RIGHT OR HEAD LEFT
FZ AXIAL	CHEST DOWN OR HEAD UP
MX MOMENT (ROLL)	LEFT SHOULDER TO LEFT EAR
MY MOMENT (PITCH)	CHEST TO CHIN
MZ MOMENT (YAW)	LEFT SHOULDER TO CHIN
FEMUR	
FX SHEAR	KNEE UP
FY SHEAR	KNEE RIGHT
FZ AXIAL	KNEE FORWARD (TENSION)
MX MOMENT (ROLL)	KNEE LEFT
MY MOMENT (PITCH)	KNEE UP
MZ MOMENT (YAW)	KNEE ROTATED CCW WHEN FACING FRONT OF DUMMY
KNEE CLEVIS - FZ AXIAL	TIBIA DOWN (TENSION)
UPPER TIBIA	
MX MOMENT	ANKLE LEFT
MY MOMENT	ANKLE FORWARD
LOWER TIBIA	
FX SHEAR	ANKLE FORWARD
FY SHEAR	ANKLE RIGHT
FZ AXIAL	ANKLE DOWN (TENSION)
MX MOMENT	ANKLE LEFT
MY MOMENT	ANKLE FORWARD
CHEST DISPLACEMENT	CHEST COMPRESSED - NEGATIVE
KNEE SHEAR DISPLACEMENT	PUSH ON FRONT OF TIBIA - NEGATIVE

NOTE: DIRECTIONS ARE DEFINED IN RELATION TO A SEATED DUMMY
REFER TO J211 FOR COMPLETE SIGN CONVENTION LIST.

11. PRETEST REQUIREMENTS....Continued

11.2 GENERAL TEST CONDITIONS

A. Surfaces of dummy components are not painted unless otherwise specified.

B. Dummy performance tests of the same component, segment, assembly, or fully assembled dummy are separated in time by a period of not less than 30 minutes unless otherwise specified.

C. Dummy performance tests are conducted at any temperature from 69°F to 72°F, unless otherwise specified and at any relative humidity from 10% to 70% after exposure of the dummy to these conditions for a period of not less than 4 hours.

D. Dummy limb joints are set at 1 G, barely restraining the weight of the limb when it is extended horizontally. The force required to move a limb segment does not exceed 2 Gs throughout the range of limb motion.

E. Dummies will be clothed for the thorax calibration tests with the exception of the shoes being removed.

12. COMPLIANCE TEST EXECUTION

12.1 EXTERNAL MEASUREMENTS

A. Place the dummy on a fiat, rigid, smooth, clean, dry, horizontal surface as shown in Figure 3A0. The seating surface is at least 16 inches wide and 16 inches in depth with a vertical section at least 16 inches wide and 36 inches high attached to the rear of the seating fixture. The dummy's midsagittal plane is vertical and centered on the test surface.

B. The dummy is secured to the test fixture so the rear surfaces of the upper thorax and buttock are tangent or as near tangent as possible to the rear vertical surface of the fixture and the dummy's midsagittal plane is vertical, Figures 4A0 .and 5A0.

C. Position the H point on each side of the dummy so it is located 3.4 ± 0.1 inches above the seat surface and 5.4 ± 0.1 inches forward of the rear vertical surface of the fixture. (The H point is located 1.83 inches forward and 2.57 inches downward from the center of the pelvic angle reference hole in the lumbar-pelvic adaptor).

Record the following measurements on the data sheet in Section 15, "External Dimensions."

D. Mark a point (AA) on the dummy's chest 17 ± 0.1 inches above the test surface. Measure and record the chest circumference (Y) at this location.

E. Mark a point (BB) on the dummy's pelvis 9 ± 0.1 inches above the test surface. Measure and record the waist circumference (Z) at this location.

F. Remove the dummy's chest skin and abdominal insert.

G. Measure and record the chest depth (0). Measurement is made at the No. 3 rib location.

H. Remove the four (4) socket head cap screws which attach the lumbar spine to the thoracic spine. Check the torque on the two (2) spine cables to be 10 lbf-in.

Note: at this point the thorax is to be inspected for damage. The thorax displacement transducer may be removed for calibration if required (pretest calibration only). Extreme caution to be used so as not to damage the instrumentation cables.

I. Reassemble the lumbar spine to the thoracic spine.

12. COMPLIANCE TEST EXECUTION.. . .Continued

J. Reposition the dummy as specified in steps a thru c, above.

K. Position the upper and lower legs parallel to the midsagittal plane so the lines between the midpoint of the knee and ankte pivots are vertical.

L. Position the feet parallel to the midsagittal plane of the dummy with the bottoms horizontal and parallel to the seating surface.

M. Position and secure the dummy's head so the occiput (back of the skull) is 1.7 ± 0.1 inches forward of the test fixture rear vertical surface. This requires some extension of the neck and also requires the upper thorax to be Secured to hold the dummy in position.

N. Position the upper arms so the lines between the midpoint of the shoulder and elbow pivots are vertical.

0. Position the lower arms so the lines between the midpoint of the elbow and wrist pivots are horizontal.

P. Record the following dimensions. (The symbols and description for each measurement are indicated.)

C "H" point height above seat-surface (Reference)

D "H" point from seat rear vertical surface (Reference)

H Skull cap skin to seat rear vertical surface (Reference)

A Total Sitting Height -
Seat surface to highest point on top of the head.

F Thigh Clearance -
Measured at the highest point on the upper femur segment.

K Buttodk to Knee Length -
The forward most part of the knee flesh to the rear vertical surface of the fixture.

N Buttock Popliteal Length -
The rearmost part of the lower leg to the rear vertical surface of the fixture.

L Popliteal Height -
Seat surface to the plane of the horizontal plane of the bottom of the feet.

M Knee Pivot Height -
Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.

P Foot Length -

Tip of toe to rear of heal.

12. COMPLIANCE TEST EXECUTION.. . .Continued

W Foot Breadth -
Measure at the widest part of the foot.

E Shoulder Pivot from Backline -
Center of the shoulder clevis to the rear vertical surface of the fixture.

V Shoulder Breadth -
Measure between outside edges of shoulder clevises in line with the shoulder pivot bolt.

B Shoulder Pivot Height -
Centerline of shoulder pivot bolt to the seat surface.

J Elbow Rest Height -
Measure from the flesh below the elbow pivot bolt to the seat surface.

I Shoulder - Elbow Length -
Measure from thehighest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.

G Back of Elbow to Wrist Pivot -
Measure from the back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots.

12. COMPLIANCE TEST EXECUTION.. ..Continued

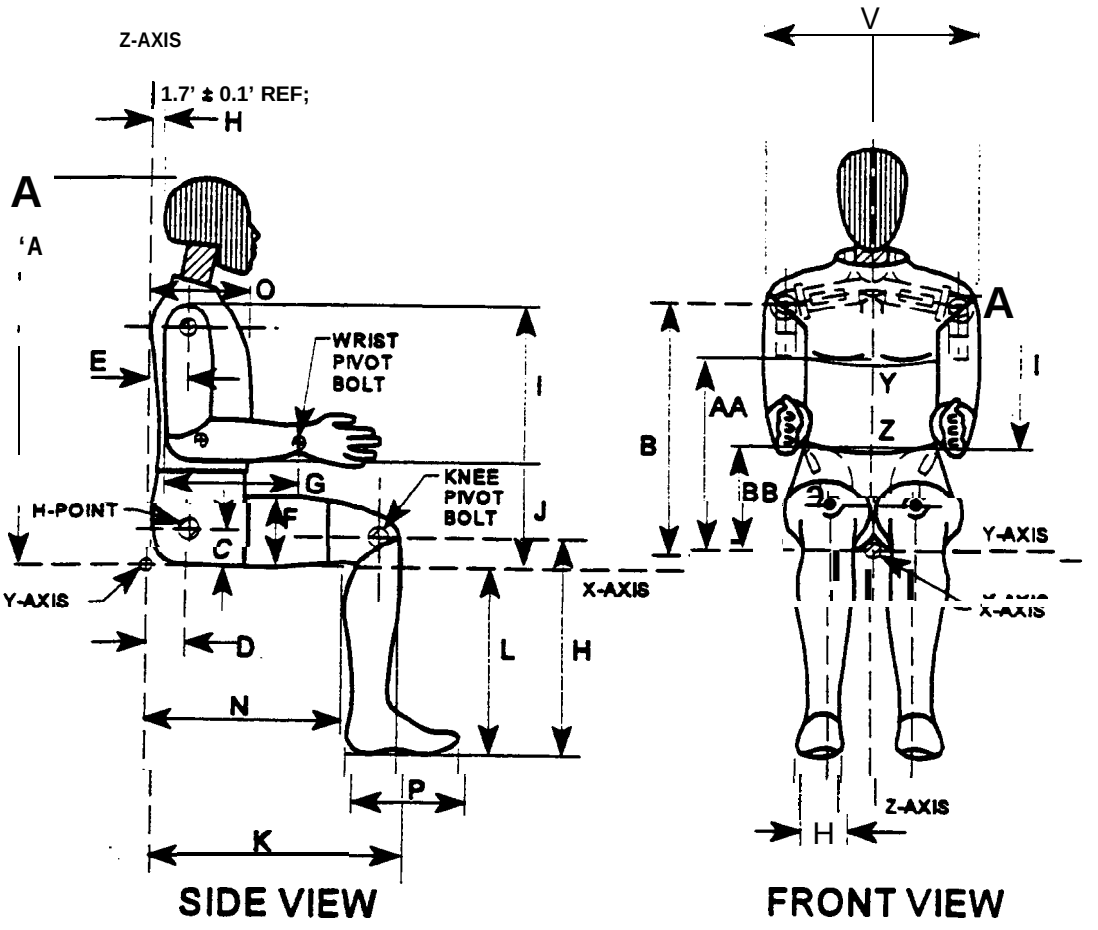
TABLE 2A0

HYBRID III EXTERIOR DIMENSIONS		
DIMENSIONAL SYMBOL	DESCRIPTION	ASSEMBLY DIMENSION
A	SITTING HEIGHT	34.8" ± 0.2"
B	SHOULDER PIVOT HEIGHT	20.2" ± 0.3"
c	H-POINT HEIGHT	3.4" REF ± 0.1"
D	H-POINT LOCATION FROM BACKLINE	5.4" REF ± 0.1"
E	SHOULDER PIVOT LOCATION FROM BACKLINE	3.5" ± 0.2"
F	THIGH CLEARANCE	5.8" ± 0.3"
G	BACK OF ELBOW TO WRIST PIVOT	11.7" ± 0.3"
H	SKULL CAP TO BACKLINE	1.7" ± 0.1"
I	SHOULDER - ELBOW LENGTH	13.3" ± 0.3"
J	ELBOW REST HEIGHT	7.9" ± 0.4"
K	BUTTOCK KNEE LENGTH	23.3" ± 0.5"
L	POPLITEAL HEIGHT	17.4" ± 0.5"
M	KNEE PIVOT HEIGHT	19.4" ± 0.3"
N	BUTTOCK POPLITEAL LENGTH	18.3" ± 0.5"
O	CHEST DEPTH	8.7" ± 0.3"
P	FOOT LENGTH	10.2" ± 0.3"
V	SHOULDER BREADTH	16.9" ± 0.3"
W	FOOT BREADTH	3.9" ± 0.3"
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	38.8" ± 0.6"
Z	WAIST CIRCUMFERENCE	33.5" ± 0.6"
AA	LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	17.0" ± 0.1"
BB	LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	9.0" ± 0.1"

NOTE: THE H-POINT IS LOCATED 1.83 INCHES FORWARD AND 2.57 INCHES DOWN FROM THE CENTER OF THE PELVIS ANGLE REFERENCE HOLE.

12. COMPLIANCE TEST EXECUTION....Continued

EXTERNAL DIMENSIONS SPECIFICATIONS



NOTE: Figun **is referenced** to the erect **seated** porition. **The curved** lumbar doer not allow **the** Hybrid **III** to be **positioned** in • **perfect** erect attitude. (REF: **S572.31(A)(6))**

FIGURE 3A0

12. COMPLIANCE TEST EXECUTION.. . .**Continued**

EXTERNAL DIMENSIONS TEST SETUP

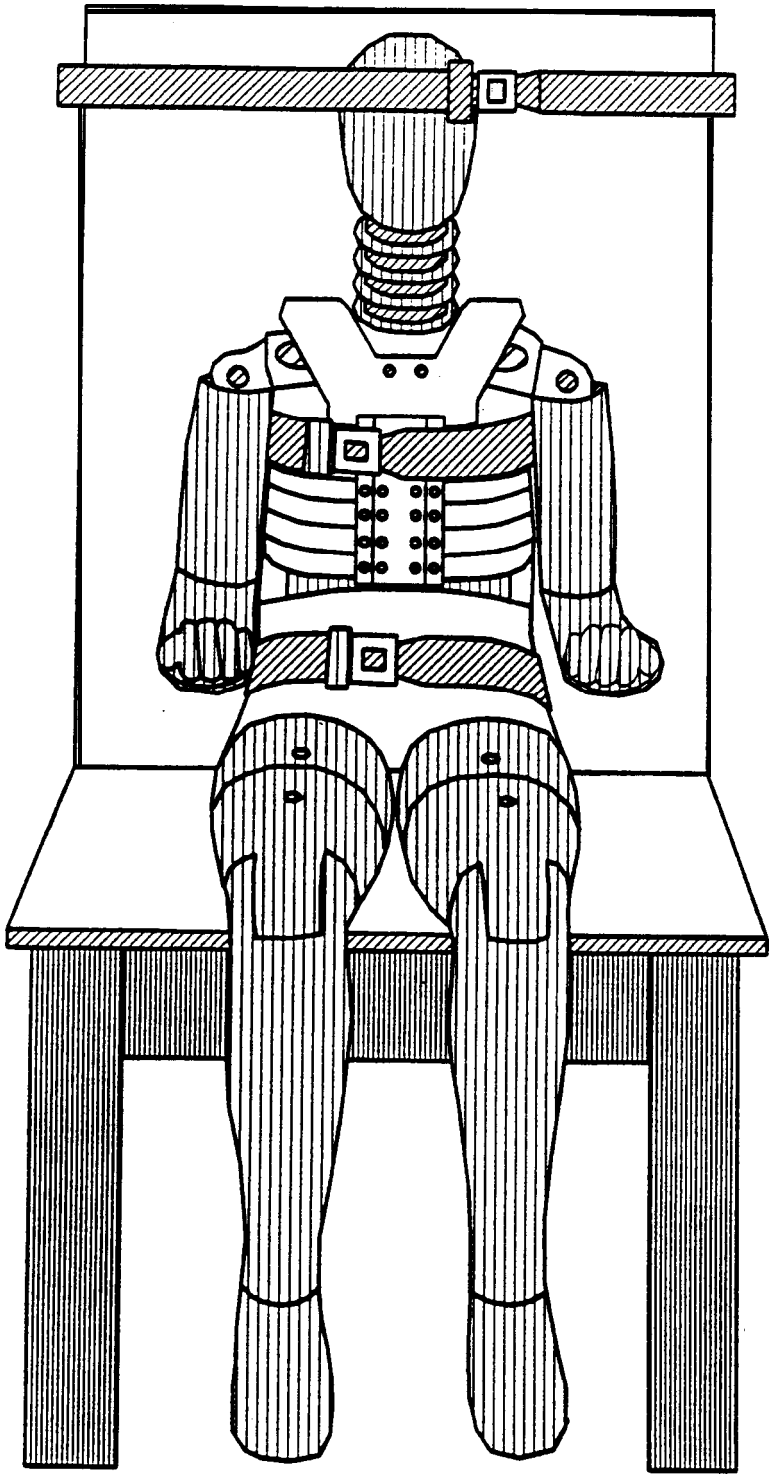


FIGURE 4A0

12. COMPLIANCE TEST EXECUTION.. . .**Continued**

EXTERNAL DIMENSIONS TEST SETUP

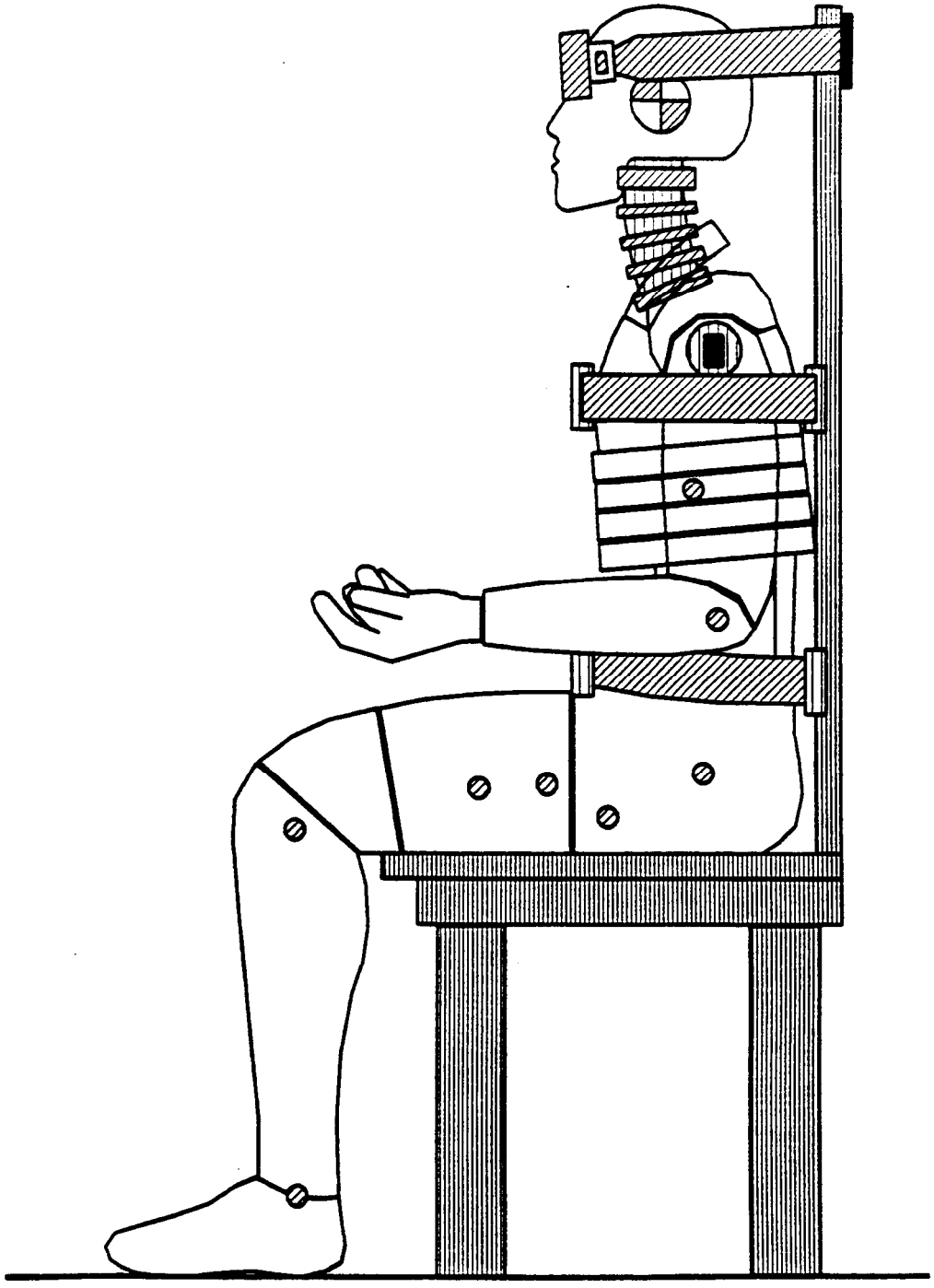


FIGURE 5A0

12. COMPLIANCE TEST EXECUTION.. . .Continued

12.2 HEAD DROP TEST

A. The head assembly consists of the head (78051-61), the neck transducer or neck transducer structural replacement (7805 l-383 revision F) or (C-1 797), the head to neck pivot pin (78051-339), and three (3) accelerometers for measuring the test parameters.

B. The weight of the head assembly is 10 pounds ± 0.1 pound.

C. The skull cap screws (1/4-20) should be torqued to 160 lbf-in.

D. Accelerometers and their respective mounts should be inspected to ensure the mounting surfaces are smooth and clean and provide a good mechanical interface. Mounting screws should be torqued to their proper value.

E. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211, June 1980 for Channel Class 1000.

12.2.1 TEST PROCEDURE

(A) Soak the head assembly in a test environment at any temperature between 66°F and 78°F and at a relative humidity from 10% to 70% for a period of at teast four (4) hours prior to a test.

(B) Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration testing completed before any replacement or repairs are made.

(C) Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test.

(D) Suspend the head assembly in a manner similar to that shown in Figure 6A0. The lowest point on the forehead is 0.5 ± 0.04 inch below the lowest point on the dummy's nose when the midsagittal plane is vertical. The 0.062 inch diameter holes located on either side of the dummy's head are used to ensure

the head is level with respect to the impact surface. A typical test setup is shown in Figure 7AO.

12. COMPLIANCE TEST EXECUTION.. . .Continued

(E) Drop the head assembly from a height of 14.8 inches ± 0.04 inches by a means that ensures a smooth, instant release onto a rigidly supported flat, horizontal steel plate with dimensions of 2 feet by 2 feet by 2 inches thick. The impact surface is to be clean and dry and have a microfinish in the range of 8 microinches to 80 microinches (rms).

NOTE:' The masses of the suspension device and the accelerometer cables are to be kept as lightweight as possible to minimize their effect on the test results.

(F) Allow a period of at least 3 hours between successive tests on the same head assembly.

12.2.2 PERFORMANCE SPECIFICATIONS (5572.32 (b))

(A) The peak resultant acceleration shall not be less than 225 Gs and not more than 275 Gs.

(B) The resultant acceleration vs. time history curve shall be unimodal to the extent that oscillations occurring after the main pulse shall not exceed 10% of the peak resultant acceleration.

(C) The lateral acceleration shall not exceed 15 Gs.

12. COMPLIANCE TEST EXECUTION....Continued

HEAD DROP TEST SETUP SPECIFICATIONS

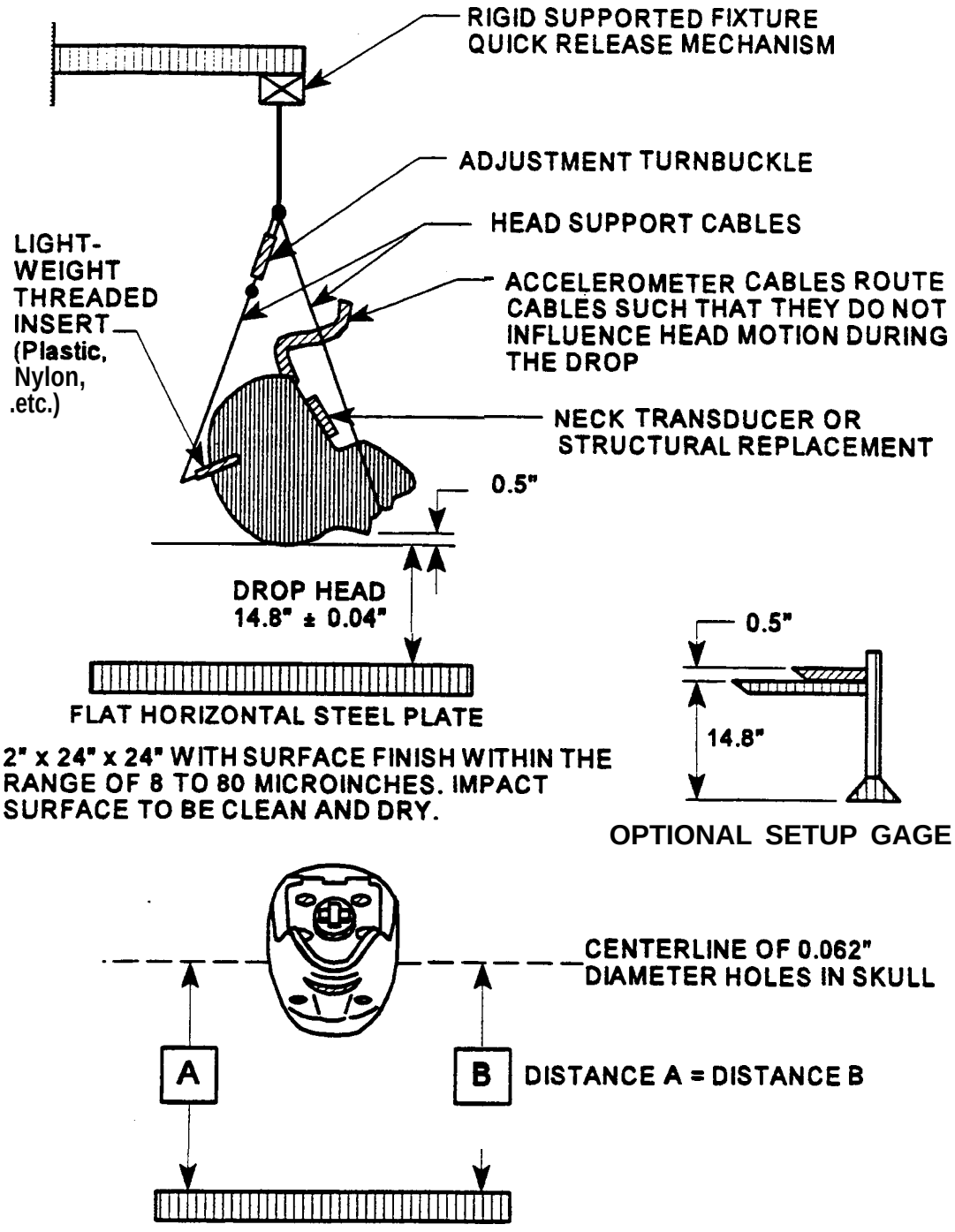


FIGURE 6A0

12. COMPLIANCE TEST EXECUTION.. . .Continued

HEAD DROP TEST SETUP

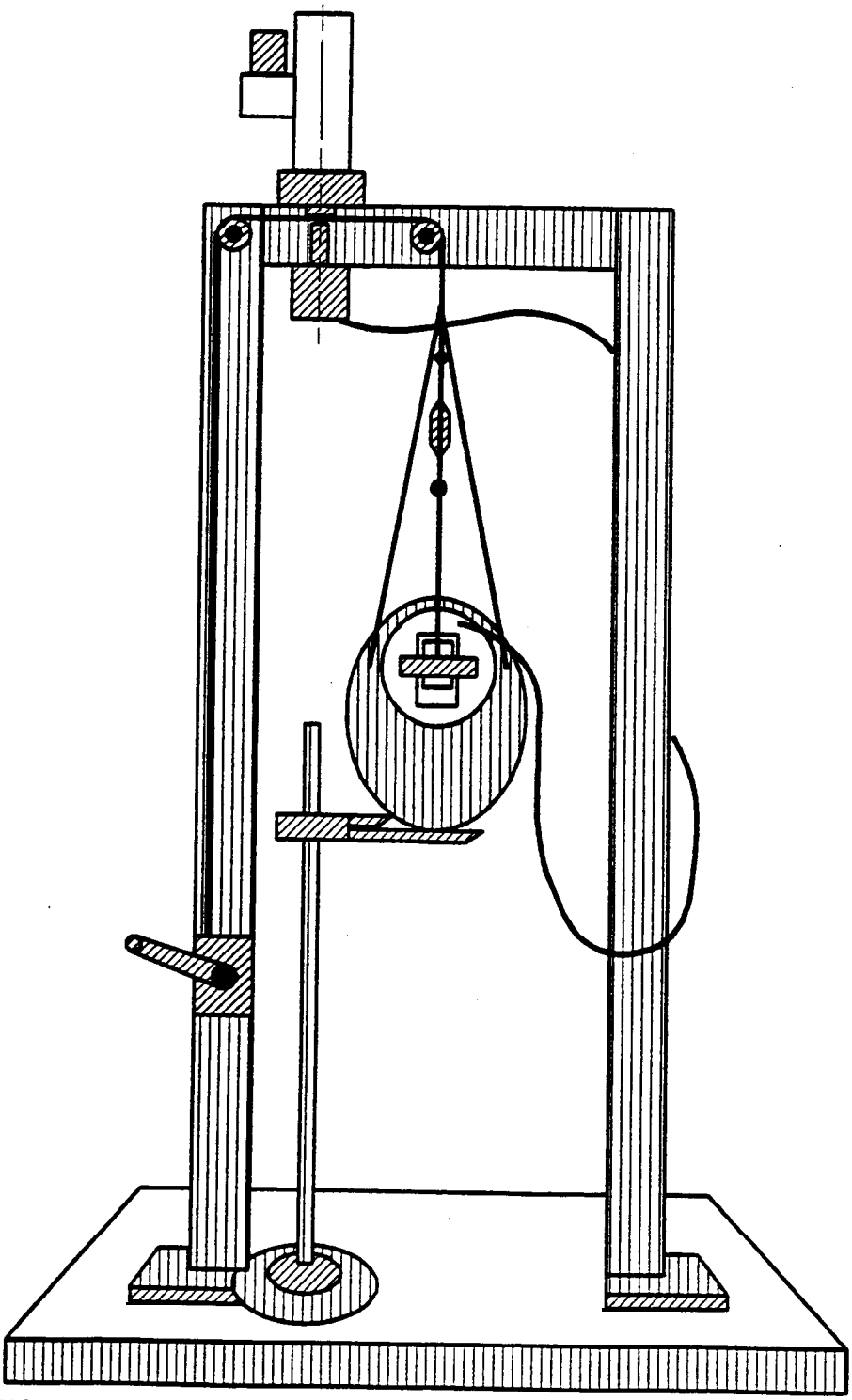


FIGURE 7A0

12. COMPLIANCE TEST EXECUTION....Continued

12.3 NECK TESTS

A. The components required for the neck tests include the head assembly (78051-61 revision T), neck assembly (78051-90 revision A), bib simulator (78051-84), upper neck adjusting bracket (78051-307 revision X) and the lower neck adjusting bracket (78051-303 revision E). Actual or simulated accelerometers may be used in the head to maintain the proper weight and center of gravity location. Data from the accelerometers are not required. A neck transducer for measuring the "X" axis force and "Y" moment data channels is required.

B. The test fixture specifications are shown in Figure 8A0. The aluminum honeycomb material is commercial grade, 1.8 lb cu ft with 0.75 inch diameter cells. The accelerometer is mounted with its sensitive axis aligned with the arc formed at a radius 65.25 inches from the pivot point.

C. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211, June 1980.

The pendulum, neck transducer and neck rotation data channels are processed using an SAE Class 60 filter.

12.3.1 TEST PROCEDURE

(A) Soak the neck assembly in a test environment at any temperature between 69°F and 72°F and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to the test.

(B) Inspect the neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration testing completed before any replacement or repairs are made.

(C) Inspect the nodding blocks (78051-351) for any deterioration and replace (pre-crash test calibration only) as necessary. At the initiation of a test series check the durometer to be 80 to 90 Shore A. Ensure the nodding blocks are installed correctly as shown on drawing 78051-90.

(D) Inspect the nodding joint washers 78051-253 for the proper interference fit. Adjust or replace as required.

12. COMPLIANCE TEST **EXECUTION....Continued**

(E) Mount the head-neck assembly on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 9AO for the flexion test and Figure 10AO for the extension test.

(F) install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11 AO.

(G) Torque the jam nut (78051-64) on the neck cable (78051-301 revision E) to 1 .O ± 0.2 lbf-ft before each test on the same neck by loosening the jam nut and relaxing the neck cable before torquing.

(H) The number of cells in the honeycomb material which are required to produce the pendulum deceleration pulse may be different for the flexion and extension tests. The number of cells required may also vary for each sheet and/or batch of material. Prior to the test the honeycomb material may require a pre-crushing by impacting it lightly with the pendulum until the desired honeycomb surface is contacting the pendulum striker plate.

(I) With the pendulum resting against the honeycomb material, adjust the neck bracket until the longitudinal centerline of the pendulum is perpendicular ± 1 degree to plane "D" on the dummy's head.

(J) Allow a period of at least thirty (30) minutes between successive tests on the same neck.

12.3.2 PERFORMANCE SPECIFICATIONS - NECK FLEXION (S572.33 (b)(1))

(A) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 22.6 to 23.4 ft/sec measured at the center of the pendulum accelerometer.

(B) Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material.

12. **COMPLIANCE TEST EXECUTION.. . .Continued**

(C) The pendulum deceleration vs. time curve must conform to the following specifications:

NECK FLEXION	
TIME	**DECELERATION LEVEL**
10 ms	22.50 Gs - 27.50 Gs
20 ms	17.60 Gs - 22.60 Gs
30 ms	12.50 Gs - 18.50 Gs
Above 30 ms	29.0 Gs Maximum

(D) **The** decaying deceleration vs. time curve shall first cross the 5 Gs level between 34 and 42 milliseconds (ms) after time-zero..

(E) The maximum rotation of plane “D” shall be 64” to 78” and occur between 57 and 64 milliseconds after time zero. The decaying rotation vs. time curve shall cross the zero angle between 113 ms and 128 ms after time-zero.

(F) The moment about the **"Y"** axis of the head, measured **with** respect to the occipital condyles, shall have a maximum value between 65 and **80 lbf-ft** and occur between 47 ms and 58 **ms.** The decaying positive moment vs. time curve shall first cross the zero moment between 97 ms and 107 ms after time-zero.

If a three (3) axis neck transducer is used, the moment about the occipital condyles is calculated using the formula:

Moment Ibf-ft = [My **(lbf-ft)]** + **[0.02875 ft] [Fx** Ibfl

If a six (6) axis’ neck transducer is used the moment is calculated using the formula:

Moment Ibf-ft = [My **(lbf-ft)]** + IO.05833 ftl **[Fx (lbf)]**

Where -- .

My = Moment in Ibf-ft measured by **the**

transducer

Fx = Force, in lbs measured by the transducer

12. COMPLIANCE TEST EXECUTION.. . .Continued

12.3.3 PERFORMANCE SPECIFICATIONS - NECK EXTENSION (S572.33(b)(2))

(A) Release the pendulum and allow it to fall freely from a height to achieve an impact velocity of 19.5 to 20.3 ft/sec measured at the center of the pendulum accelerometer.

(B) Time-zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material.

(C) The pendulum deceleration vs. time curve must conform to the following specifications:

NECK EXTENSION	
TIME	DECELERATION LEVEL
10 ms	17.20 Gs - 21.20 Gs
20 ms	14.00 Gs - 19.00 Gs
30 ms	11.00 Gs - 16.00 Gs
Above 30 ms	22.0 Gs Maximum

(D) The decaying deceleration vs. time curve shall first cross the 5 Gs level between 38 ms and 46 ms after time-zero.

(E) The maximum rotation of plane "D" shall be 81 ° to 106" and occur between 72 ms and 82 ms after time-zero. The decaying rotation vs. time curve shall cross the zero angle between 147 ms and 174 ms after time-zero.

(F) The moment about the "Y" axis of the head measured with respect to the occipital condyles shall have a minimum value between -39 lbf-ft and -59 lbf-ft and occur between 65 ms and 79 ms after time-zero. The decaying negative moment shall first cross the zero level between 120 ms and 148 ms after time-zero.

The moment about the occipital condyles is calculated using the following formulas: (as listed in section 12.3.2 item f)

If a three ‘(3) axis neck transducer is used, the moment about the occipital condyles is calculated using the formula:

Moment Ibf-ft = [My (lbf-ft)] + LO.02875 ftl [Fx Ibf]

12. COMPLIANCE TEST EXECUTION....Continued

If a six (6) axis neck transducer is used the moment is calculated using the formula:

Moment Ibf-ft = [My (lbf-ft)] + [0.05833 ft] [Fx (lbf)]

Where --

My = Moment in Ibf-ft measured by the transducer

Fx = Force, in Ibs measured by the transducer

12. COMPLIANCE TEST EXECUTION....Continued

NECK PENDULUM SPECIFICATIONS

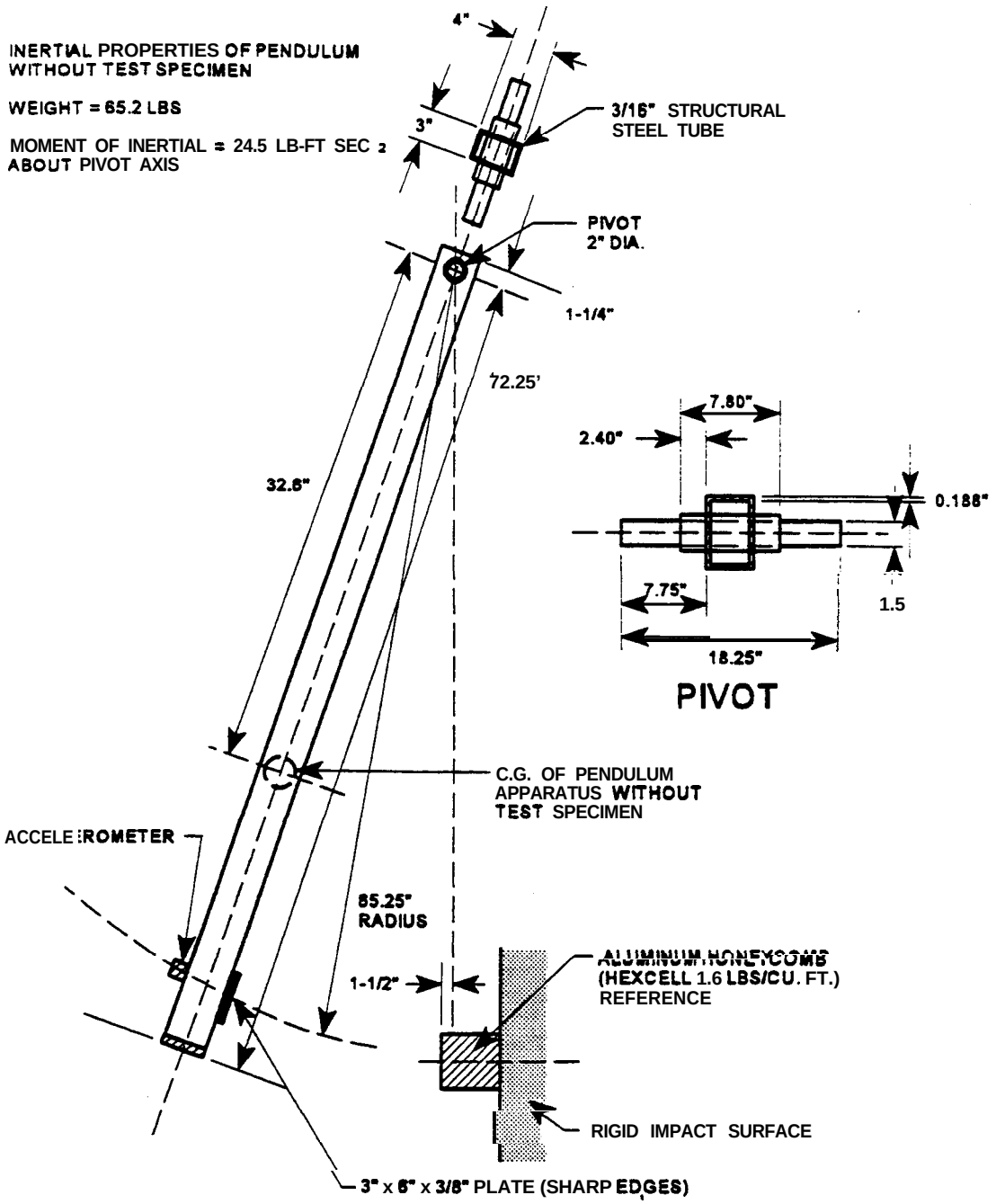


FIGURE 8A0

12. COMPLIANCE TEST EXECUTION....Continued

NECK FLEXION TEST SETUP SPECIFICATIONS

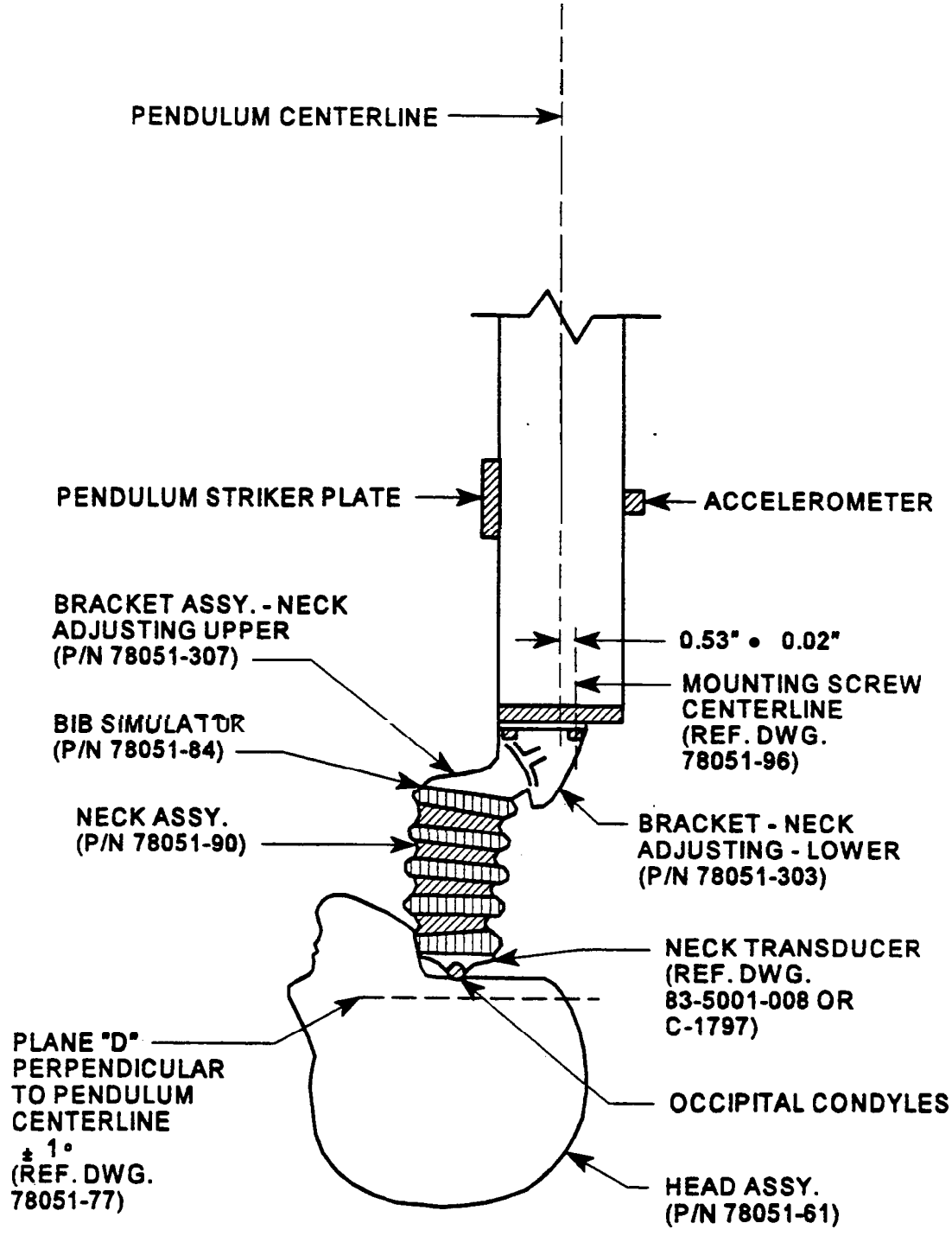


FIGURE 9AO

12. COMPLIANCE TEST EXECUTION....Continued

NECK EXTENSION TEST SETUP SPECIFICATIONS

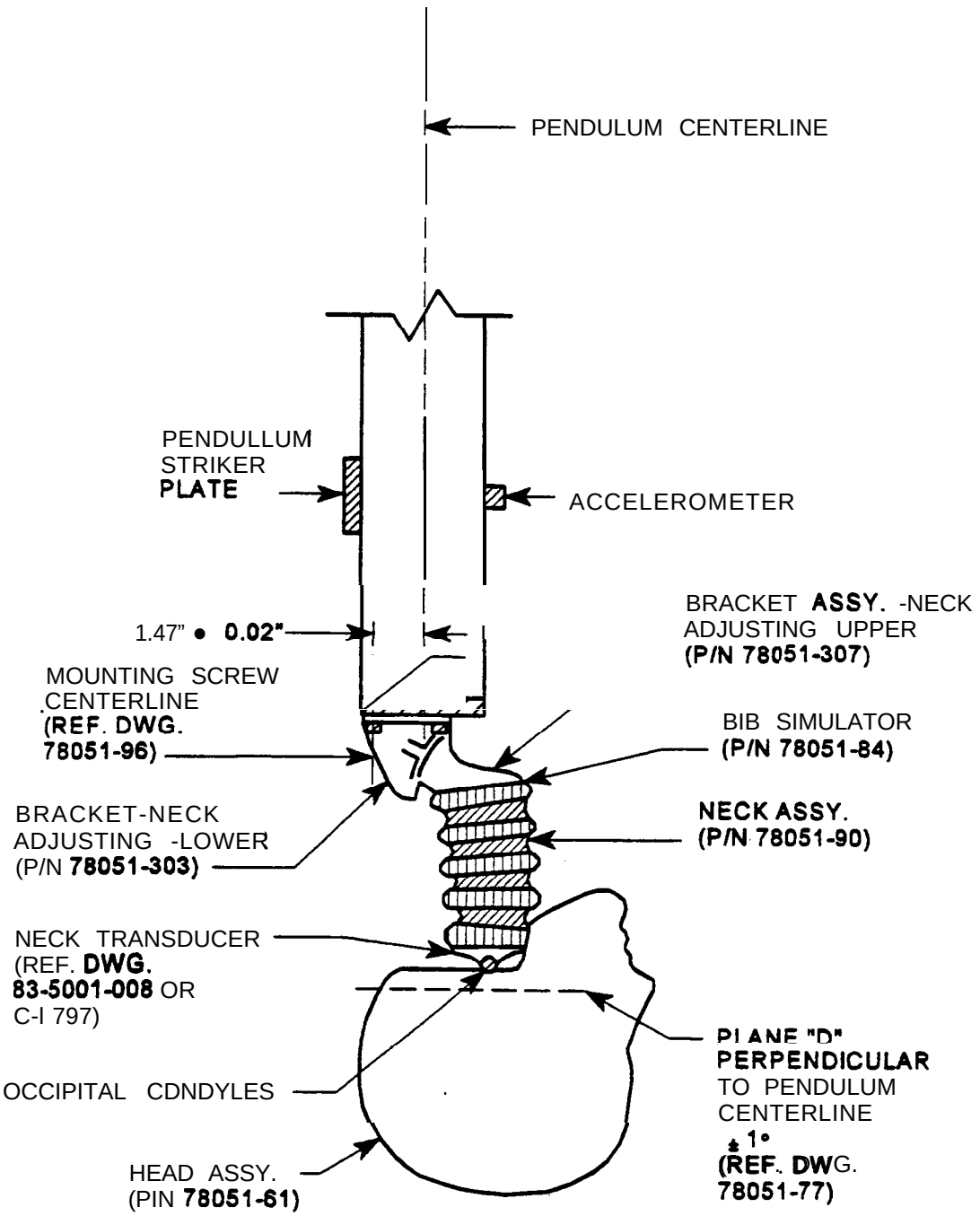


FIGURE 1 OAO

12. COMPLIANCE TEST EXECUTION. . . .Continued

ROTATION TRANSDUCER ASSEMBLY

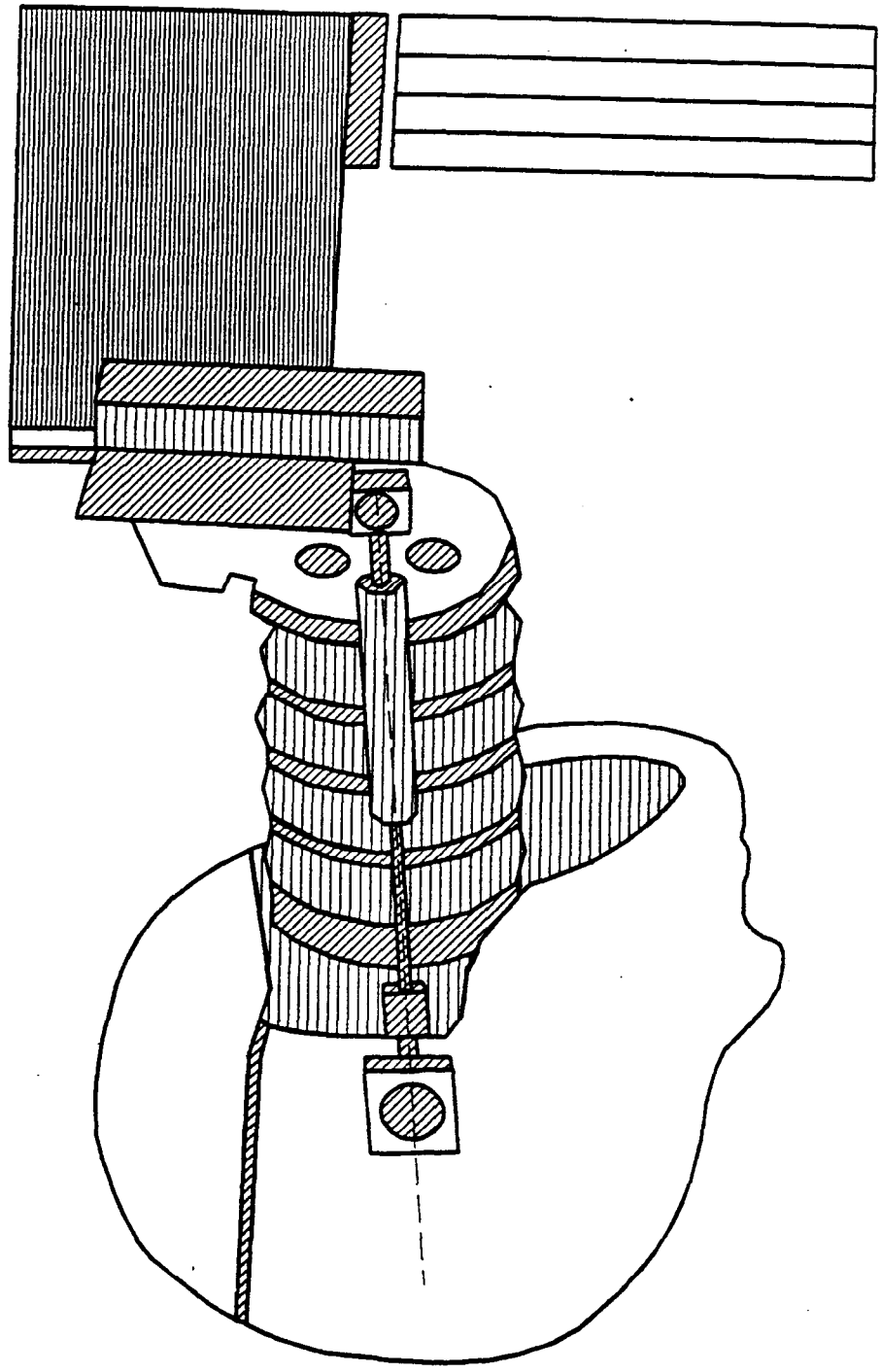


FIGURE 11 AO

12. COMPLIANCE TEST EXECUTION....Continued

12.4 KNEE IMPACT TEST

A. The components required for the knee impact test include the **leg** assemblies (86-5001-001) left and (86-5001-002) right with the upper leg assemblies, (78051-46) left and (78051-47) right removed.

B. The test fixture, Figure 12AO, consists of a rigid test probe and a method of rigidly supporting the knee and lower leg assembly. The probe mass is 11 lbs ± 0.02 Ibs including instrumentation. The diameter of the impacting face is 3 inches ± 0.01 inches with an edge radius of 0.02 inch. An accelerometer is mounted on the end opposite from the impacting face with its sensitive axis colinear to the longitudinal centerline of the test probe.

C. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211 June 1980 for Channel Class 600.

12.4.1 TEST PROCEDURE

(A) inspect the knee assembly for cracks, cuts, abrasions, etc. Repair or replace damaged components. NOTE: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged areas are to be documented with photography and the post-test calibration testing completed before any repairs or replacements are made.

(B) Soak the knee in an environment at any temperature between 66°F and 78°F and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to its application in a test.

(C) Mount the knee/lower leg assembly to the fixture using the load cell or load cell simulator (78051-319 revision A). Torque the load cell simulator bolts to 30 Ibf-ft to ensure there is no slippage of the assembly during the impact. Adjust the lower leg so the line between the knee and ankle pivots is at an angle of 24' rearward of vertical. No contact is permitted between the foot and any exterior surface.

(D) Align the longitudinal centerline of the test probe so it is **colinear** within 2 degrees with the longitudinal centerline of the load cell simulator at the time of impact.

(E) **Guide** the probe so there is no significant lateral, vertical or rotational movement at time-zero.

12. COMPLIANCE TEST EXECUTION., . .Continued

(F) Time-zero is defined as the time of initial contact between the test probe face and the knee skin.

(G) Impact the knee so the longitudinal centerline of the test probe is within 0.5" of a horizontal line parallel to the load cell simulator at time-zero.

(H) The velocity of the test probe at the time of impact is 6.9 ft/sec ± 0.1 ft/sec.

12.4.2 PERFORMANCE SPECIFICATIONS (S572.35 (b))

The peak impact force, defined as the product of the test probe mass and the deceleration, shall be between 1060 and 1300 lbs.

12. COMPLIANCE TEST EXECUTION.. . .Continued

KNEE IMPACT TEST SETUP SPECIFICATIONS

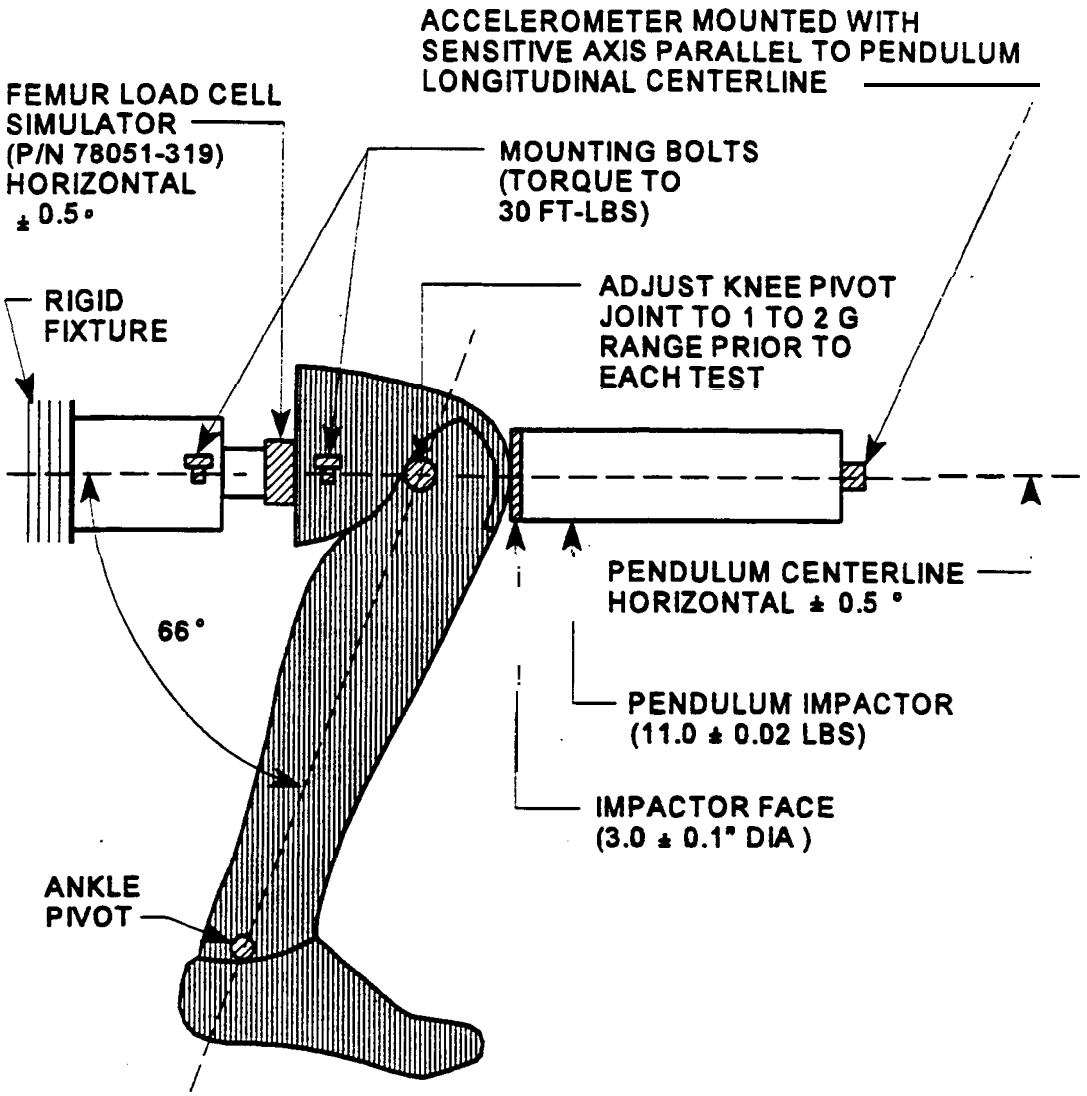


FIGURE 12AO

12. **COMPLIANCE TEST EXECUTION . . . .Continued**

12.5 THORAX IMPACT TEST

A. The complete assembled dummy (78051-218 revision R) is required including the clothing (vest (78051-292) and panty (78051-293)) but without the shoes, (78051-294) left and (78051-295) right,

B. The test setup specifications are shown in Figure 13AO. The fixture consists of a smooth, clean, dry, steel seating surface and a test probe. The test probe is a 6 inches ± 0.01 inch diameter rigid cylinder with a mass of 51.5 lbs ± 0.05 lbs including instrumentation. The impacting surface has a flat, right angle, face with an edge radius of 0.5 inch. An accelerometer is mounted on the end opposite from the impacting end with its sensitive axis colinear to the longitudinal centerline of the test probe. A test setup is shown in Figure 14A0.

C. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211 June 1980 Class 180.

12.5.1 TEST PROCEDURE

(A) Remove the chest skin and visually inspect the thorax assembly for cracks, cuts, abrasions, etc. Particular attention should be given to the rib damping material (78051-l 7 thru 78051-22), chest displacement transducer assembly (78051-317) and the rear rib supports (78051-304). Inspect for rib deformation using the chest depth gage (83-5006-007). If any damage is noted. repair and/or replace the damaged components unless the damage resulted from the vehicle crash test in which the dummy was an occupant in which case the damage must be documented and post test calibration testing completed before any repairs or replacements are made.

(B) Soak the test dummy in an environment with a relative humidity from 10% to 70% for at least four (4) hours and until the temperature of the ribs have stabilized at a temperature between 69°F to 72°F. The temperature as measured, on the surface of the ribs and also the ambient within the laboratory are recorded.

(C) Seat the dummy, (chest skin still removed) without back and arm supports on the test fixture surface as shown in Figure 13A0. The surface must be sufficiently long enough to support the pelvis and outstretched legs.

12. COMPLIANCE TEST EXECUTION....Continued

(D) Align the adjustable neck bracket 78051-303 and 78051-307 index marks to the "zero" position.

(E) Place the arm assemblies horizontal ± 2" and parallel to the midsagittal plane. The arms are held in place by tightening the adjustment nut (78051-251) which holds the arm yoke to the clavicle assembly (7805 l-l 41). Level the ribs both longitudinally and laterally ± 0.5" and adjust the pelvis angle to 13" ± 2'. (A special tool is required which inserts into the pelvic structure and extends outward beyond the pelvic skin surface.) The tool permits the use of an angle measurement device to determine the pelvis angle. The midsagittal plane of the dummy is vertical ± 2" of being perpendicular to the centerline of the test probe. The longitudinal centerline of the test probe is centered on the midsagittal plane of the dummy centerline is 0.5 inch ± 0.04 inch below the horizontal centerline of the No. 3 rib and is within 0.5" of a horizontal line in the dummy's midsagittal plane. After the initial locations such as.the rear surfaces of the thoracic spine and the lower neck bracket reference measurements are recorded from locations such as the rear surfaces of the thoracic spine and the lower neck bracket. These reference measurements are necessary to ensure the dummy is in the same position after the chest skin is installed. The reference locations must be accessible after installation of the chest skin. It may be necessary to leave the chest skin zipper unfastened until the references are checked and fasten it just prior to the test.

(F) Install the chest skin and reposition the dummy as'described in the preceding paragraph using the reference measurements recorded.

(G) Impact the thorax with the test probe so the longitudinal centerline of the probe is 2° of a horizontal line in the dummy's midsagittal plane at the moment of impact.

(H) Guide the probe so there is no significant lateral, vertical or rotational movement during the impact.

(I) The velocity of the test probe at the time of impact is 22 ft/sec ± 0.4 ft/sec.

(J) Time zero is defined as the time of initial contact between the test probe and the chest skin.

(K) Allow a period of at least thirty (30) minutes between successive tests on the same thorax.

12. COMPLIANCE TEST EXECUTION....Continued

12.5.2 PERFORMANCE SPECIFICATIONS (S572.34)

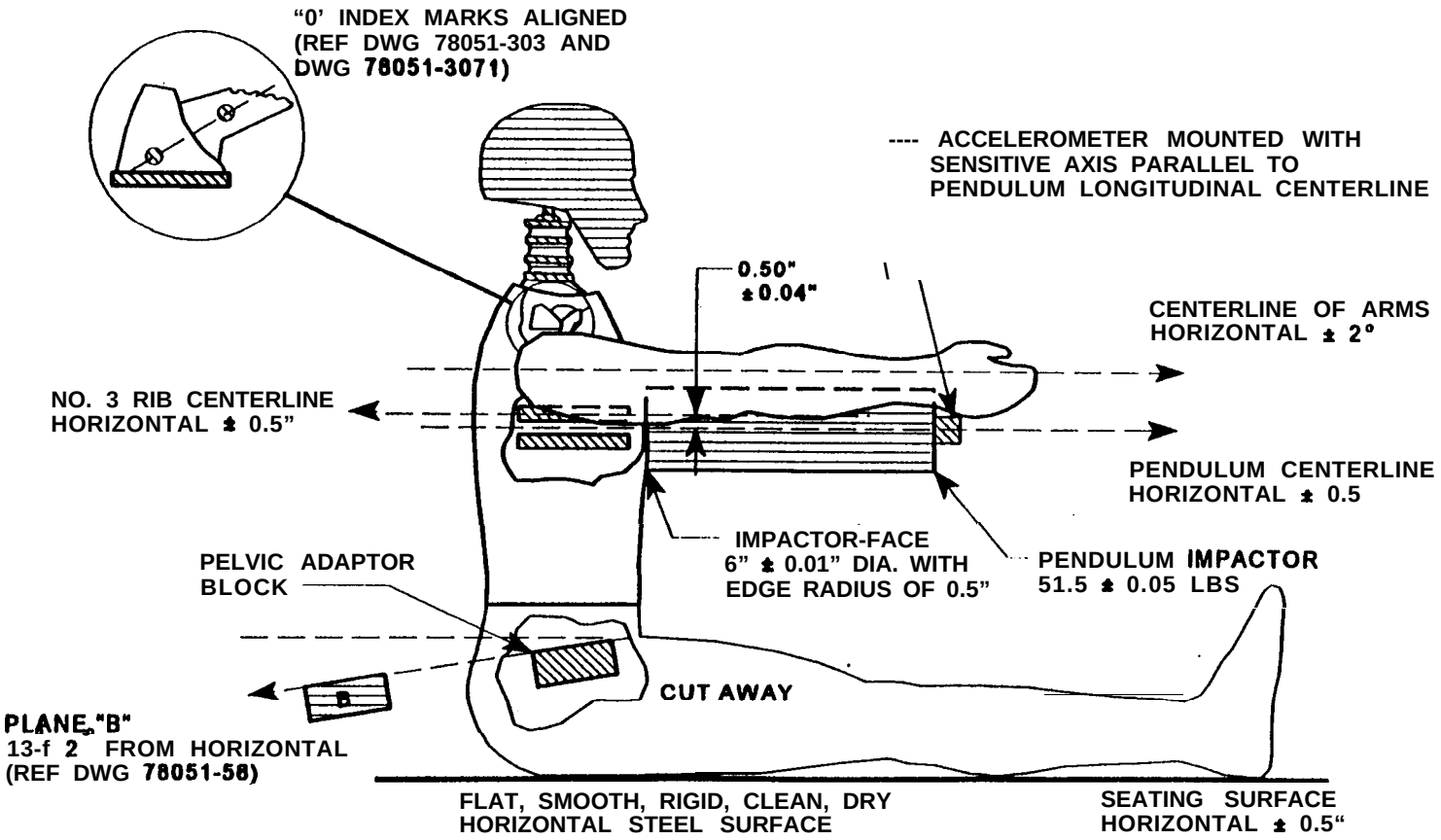
(A) The resistive forces of the thorax as measured by the test probe shall be between 1160 Ibs and 1325 Ibs. The resistive force is the product of the test probe deceleration and mass.

(B) The sternum displacement as measured by the chest displacement transducer shall be between 2.50 inches and 2.86 inches.

(C) The internal hysteresis shall be more than 69% but less than 85%. The hysteresis is determined from the force vs deflection curve and is the ratio of the area between the loading and unloading portions of the curve to the area under the loading portion of the curve as shown in Figure 15A0.

FIGURE 13AO

THORAX IMPACT TEST SETUP SPECIFICATIONS



NOTE:
(A) NO EXTERNAL SUPPORT IS REQUIRED ON THE DUMMY TO MEET SETUP SPECIFICATIONS
(B) THE MIDSAGITTAL PLANE OF THE DUMMY IS VERTICAL (± 1) AND WITHIN 2 OF PENDULUM CENTERLINE
(C) THE MIDSAGITTAL PLANE OF THE DUMMY IS CENTERED ON THE PENDULUM CENTERLINE WITHIN 0.12"

12. COMPLIANCE TEST EXECUTION....Continued

THORAX IMPACT TEST SETUP

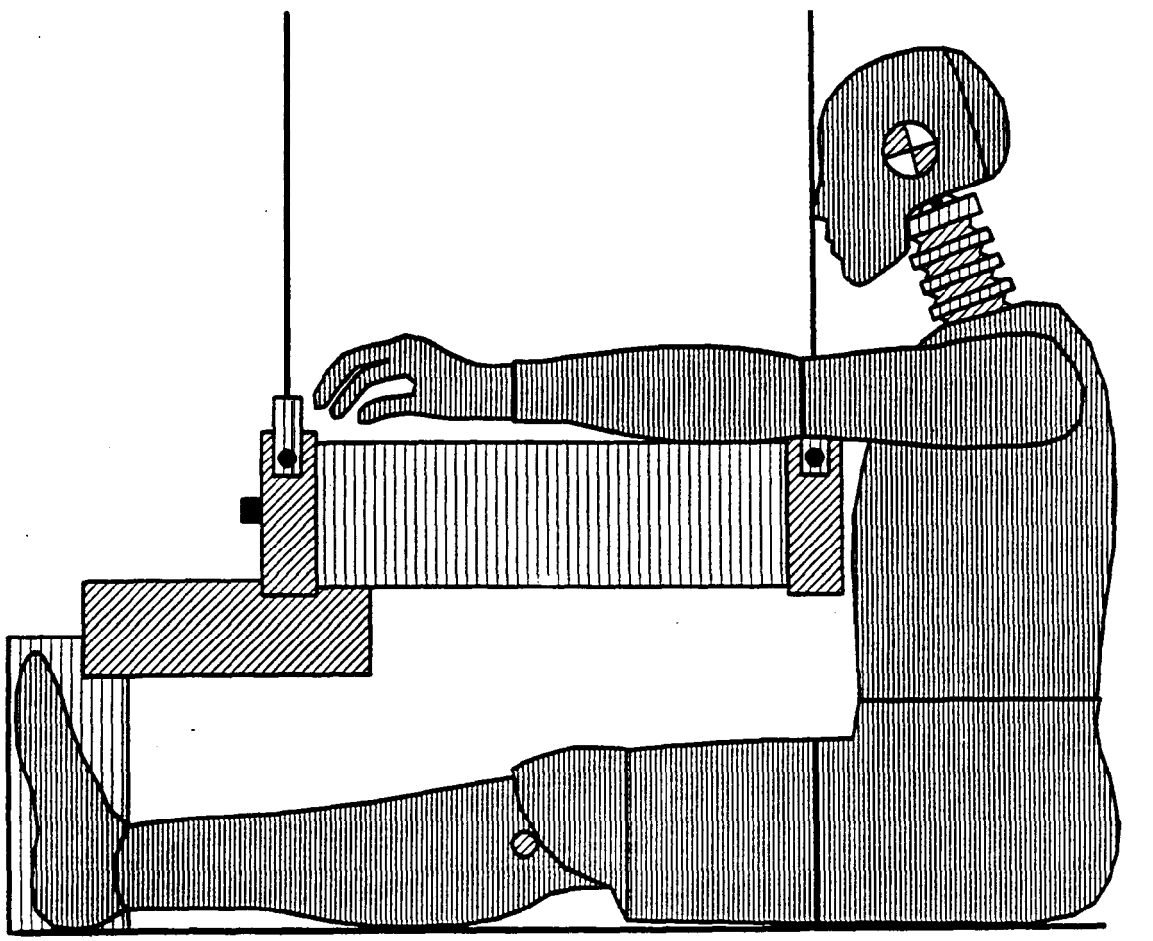
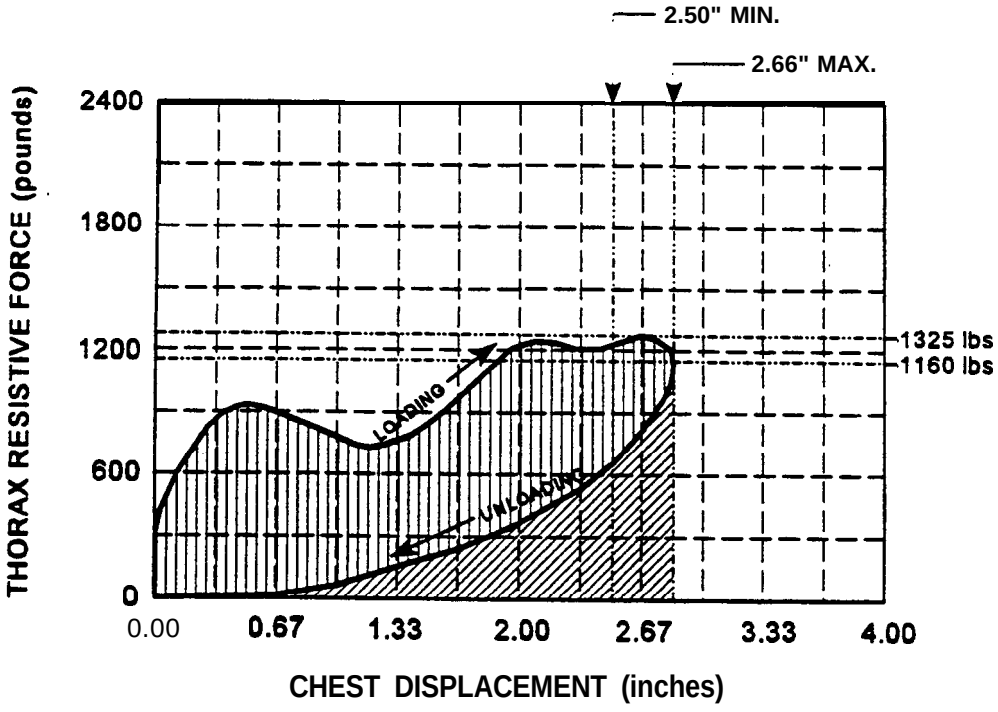


FIGURE 14A0

12. COMPLIANCE TEST EXECUTION....Continued



PART 572E HYBRID III THORAX CALIBRATION -HYSTERESIS

FIGURE 15A0

13. POST TEST REQUIREMENTS

The contractor shall verify all instrumentation and check data sheets and photographs. Make sure data is recorded in all data blocks on every performance calibration test data sheet.

14. INTENTIONALLY BLANK

15. DATA SHEETS (EXAMPLES)

DATA SHEETS ARE TO BE INCLUDED AND SUBMITTED WITH EACH NCAP VEHICLE TEST REPORT. DATA TRACES ARE TO BE KEPT ON FILE.

PART 572E EXTERNAL DIMENSIONS

MANUFACTURER/ID NO.			
CALIBRATION DATE			
TEST PARAMETER		**SPECIFICATION**	**TEST RESULT**
TEMPERATURE			72.0°F
RELATIVE HUMIDITY			27.0%
LOCATION FOR CHEST CIRCUMFERENCE	AA	16.9" - 17.1"	17.0"
LOCATION FOR WAIST CIRCUMFERENCE	BB	8.9" - 9.1"	9.0"
CHEST CIRCUMFERENCE (WITH JACKET)	Y	38.2" - 39.4"	38.6"
WAIST CIRCUMFERENCE	Z	32.9" - 34.1"	33.7"
CHEST DEPTH	O	8.4" - 9.0"	8.7"
H-POINT HEIGHT	C	3.3" - 3.5"	3.4"
H-POINT FROM BACKLINE	D	5.3" - 5.5"	5.4"
SKULL CAP TO BACKLINE	H	1.6" - 1.8"	1.7"
TOTAL SITTING HEIGHT	A	34.6" - 35.0"	34.6"
THIGH CLEARANCE	F	5.5" - 6.1"	6.0"
BUTTOCK KNEE LENGTH	K	22.8" - 23.8"	23.1"
BUTTOCK POPLITEAL LENGTH	N	17.8" - 18.8"	18.6"
POPLITEAL HEIGHT	L	16.9" - 17.9"	17.4"
KNEE PIVOT HEIGHT	M	19.1" - 19.7"	19.6"
FOOT LENGTH	P	9.9" - 10.5"	10.1"
FOOT BREADTH	W	3.6" - 4.2"	4.1"
SHOULDER PIVOT FROM BACKLINE	E	3.3" - 3.7"	3.4"
SHOULDER BREADTH	V	16.6" - 17.2"	16.8"
SHOULDER PIVOT HEIGHT	B	19.9" - 20.5"	20.1"
ELBOW REST HEIGHT	J	7.5" - 8.3"	8.1"
SHOULDER - ELBOW LENGTH	I	13.0" - 13.6"	13.5"
BACK OF ELBOW TO WRIST PIVOT	G	11.4" - 12.0"	11.4"

LABORATORY TECHNICIAN: _____

15. DATA SHEETS (EXAMPLES)....Continued

PART 572E

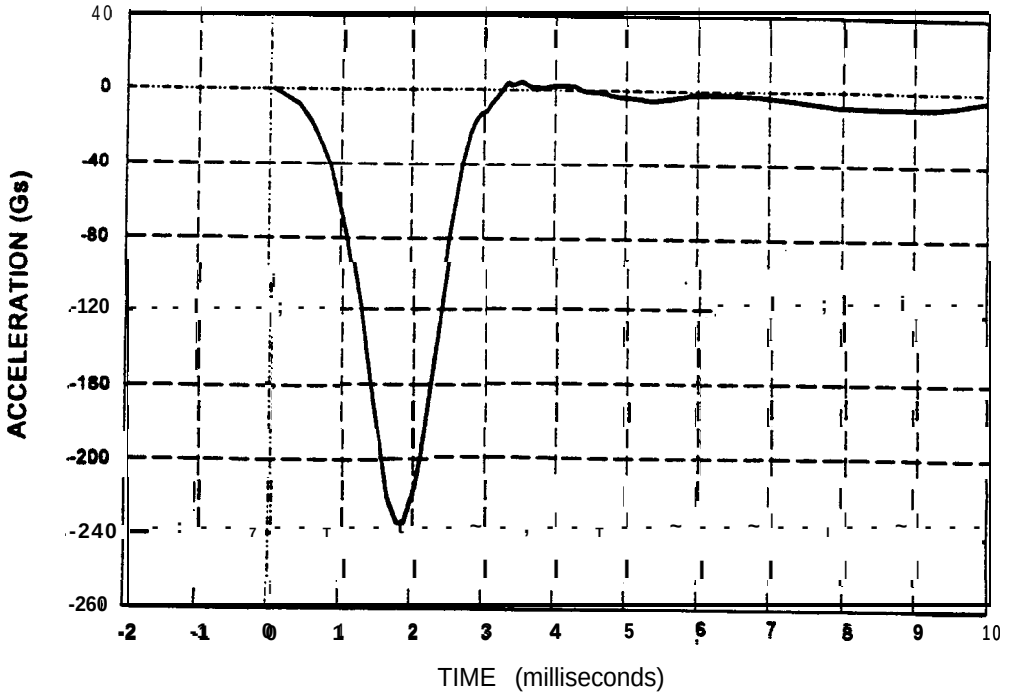
HEAD DROP TEST

MANUFACTURER/ID NO.		
CALIBRATION DATE		
TEST PARAMETER	**SPECIFICATION**	TESTRESULTS
TEMPERATURE	66°F - 78°F	72°F
RELATIVE HUMIDITY	**10% - 70%**	27%
PEAK RESULTANT ACCELERATION	225 Gs - 275 Gs	270.63 Gs
PEAK LATERAL ACCELERATION	15 Gs Maximum	-7.43 Gs
IS ACCELERATION CURVE UNIMODAL?	YES	YES

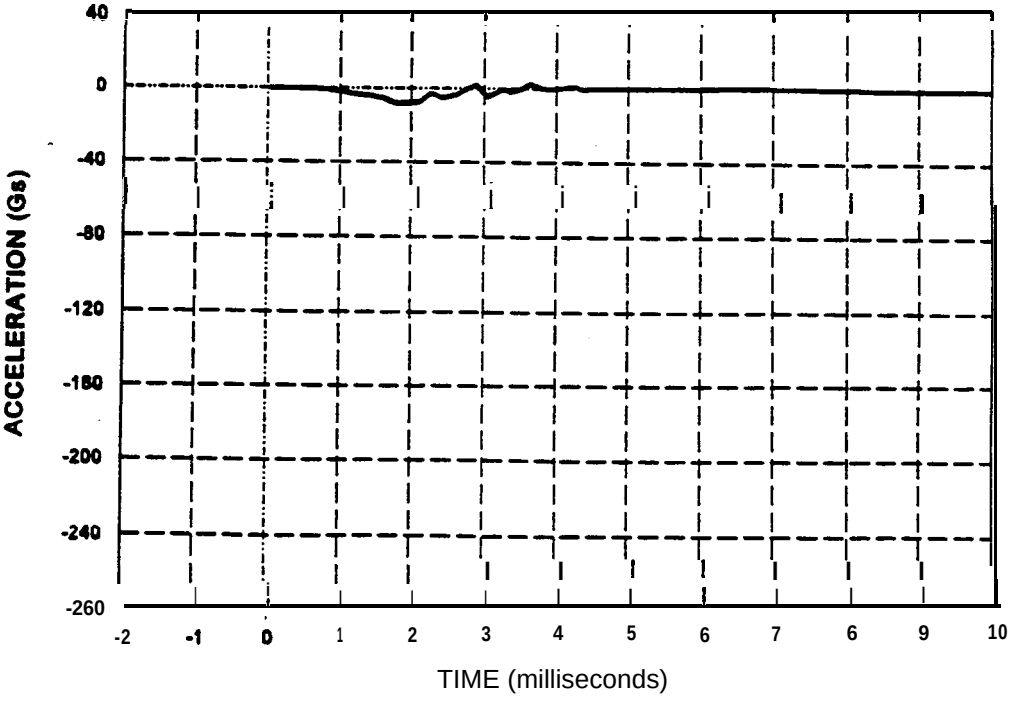
REMARKS:

LABORATORY TECHNICIAN: _____

15. DATA SHEETS (EXAMPLES)....Continued

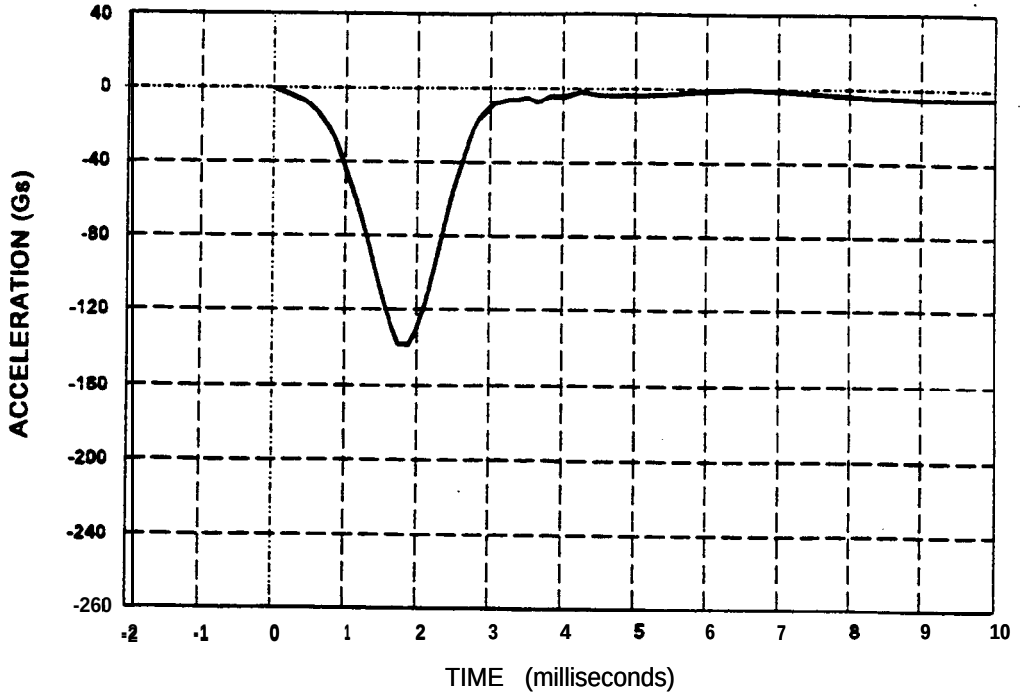


PART 572-E HYBRID III HEAD CALIBRATION - HEAD ACCELERATION X AXIS

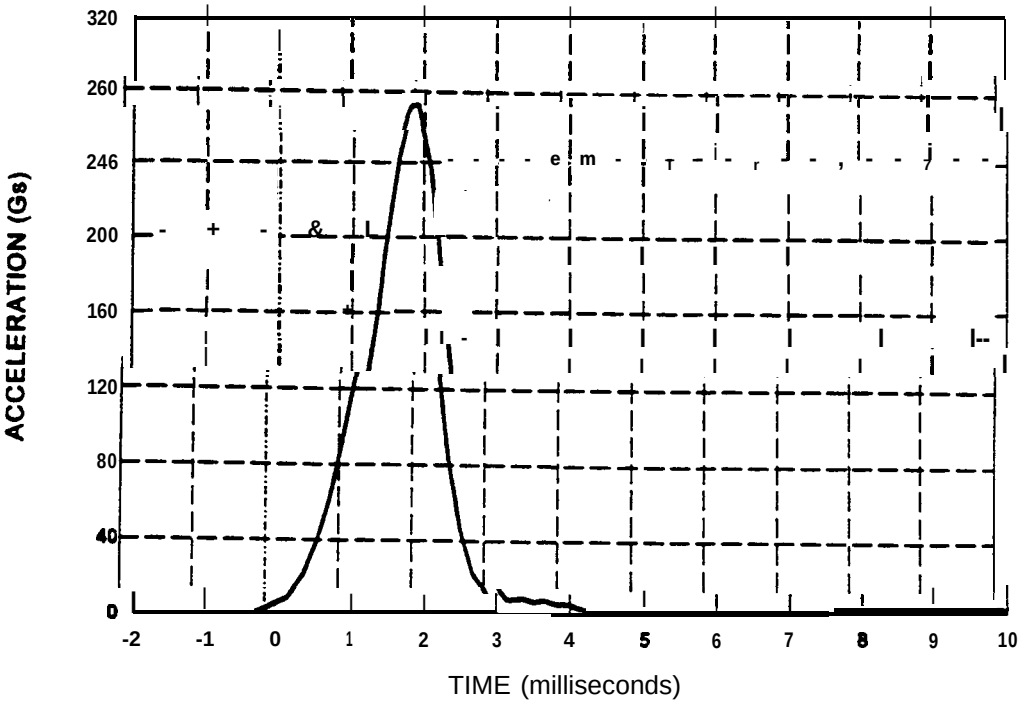


PART 572-E HYBRID III HEAD CALIBRATION - HEAD ACCELERATION Y AXIS

15. DATA SHEETS (EXAMPLES)....Continued



PART 572-E HYBRID III HEAD CALIBRATION - HEAD ACCELERATION Z AXIS



PART 572-E HYBRID III HEAD CALIBRATION - HEAD RESULTANT ACCELERATION

15. **DATA SHEETS (EXAMPLES)....Continued**

PART 572E

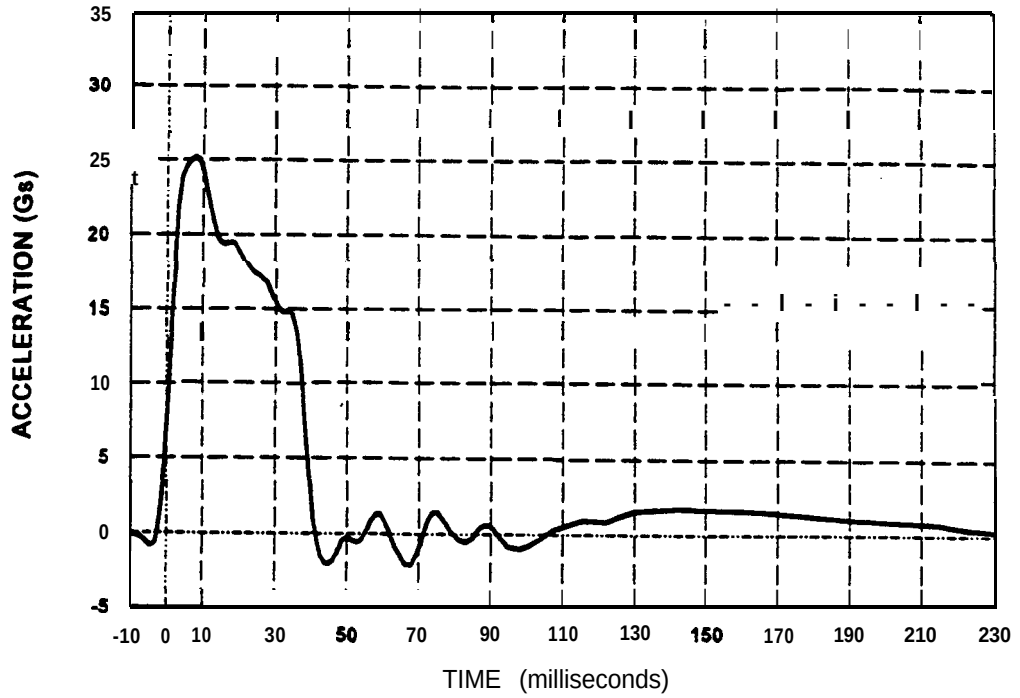
NECK FLEXION TEST

MANUFACTURER/ID NO.			
CALIBRATION DATE			
TEST PARAMETER		**SPECIFICATION**	**TEST RESULTS**
TEMPERATURE		69°F - 72°F	72°F
RELATIVE HUMIDITY		10% - 70%	49%
IMPACT VELOCITY		22.6 - 23.4 ft/sec	23.30 ft/sec
PENDULUM DECELERATION	10 ms	22.50 Gs - 27.50 Gs	23.51 Gs
	20 ms	17.60 Gs - 22.60 Gs	18.57 Gs
	30 ms	12.50 Gs - 18.50 Gs	15.03 Gs
MAX PENDULUM G ABOVE 30 MS		29 Gs	14.99 Gs
DECELERATION - TIMECURVE DECAY TIME TO 5 Gs		34 ms - 42 ms	38.13 ms
D PLANE ROTATION		64°F - 78°F Maximum	71.46°F
		TIME: 57 ms - 64 ms	60.13 ms
MOMENT ABOUT OCCIPITAL CONDYLE		65 - 80 ft-lbs Maximum	76.32 ft-lbs
		TIME: 47 ms - 58 ms	52.88 ms
ROTATION AN GLE-TIME CURVE DECAY TIME TO ZERO		113 ms - 128 ms	115.75 ms
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		97 ms - 107 ms	100.25 ms

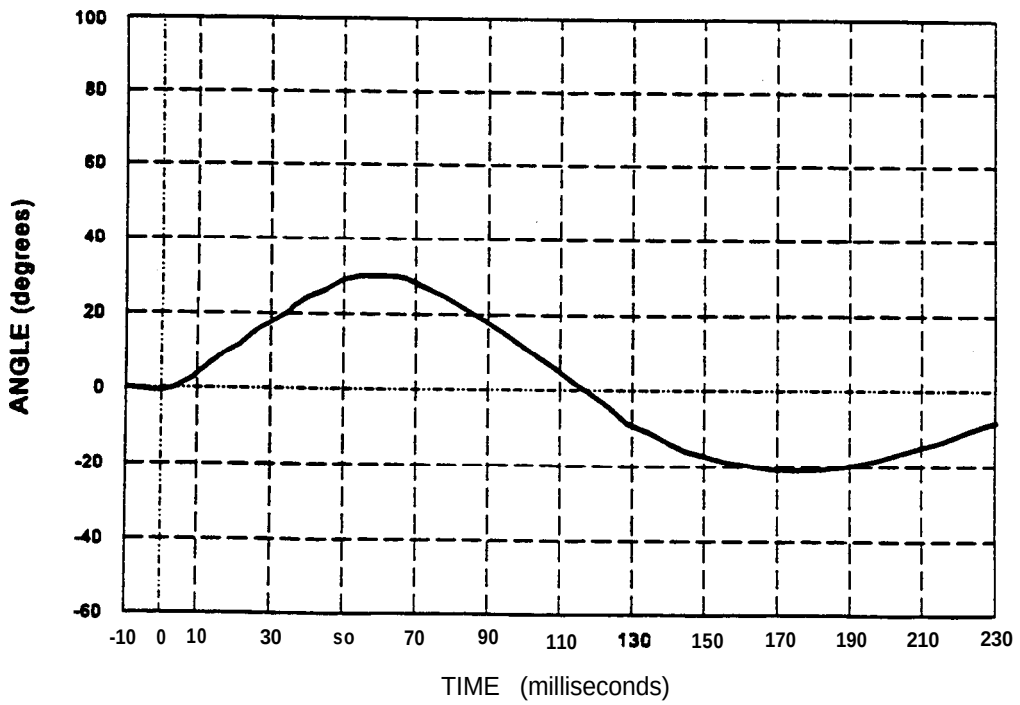
REMARKS:

LABORATORY TECHNICIAN: _____

15. DATA SHEETS (EXAMPLES)....Continued

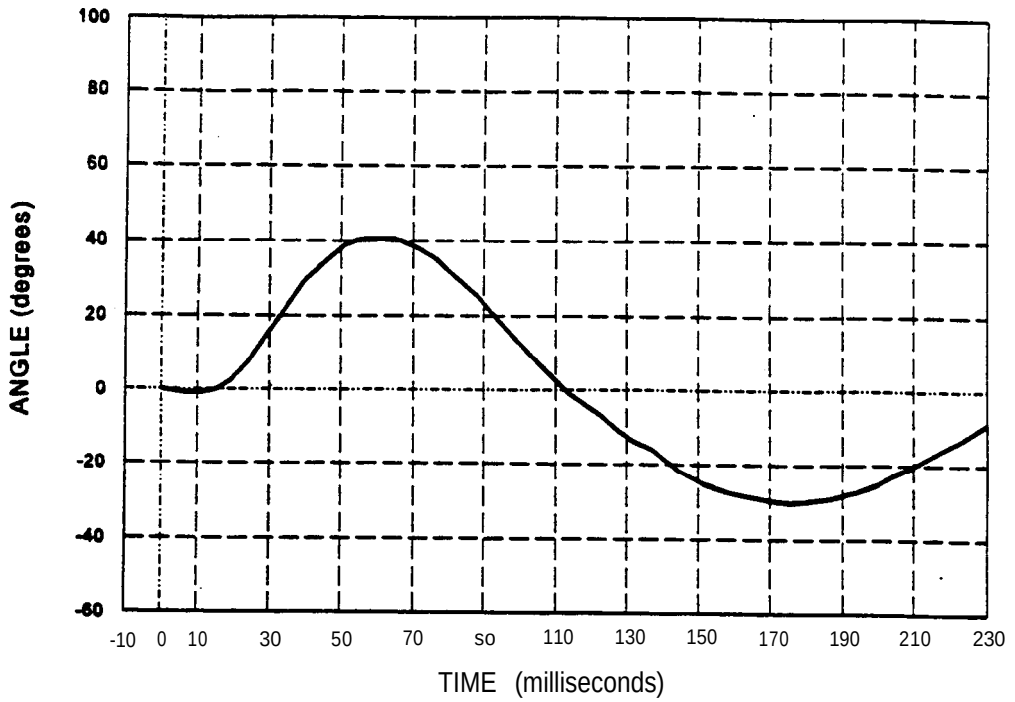


PART 572-E HYBRID III NECK FLEXION CALIBRATION - PENDULUM DECELERATION

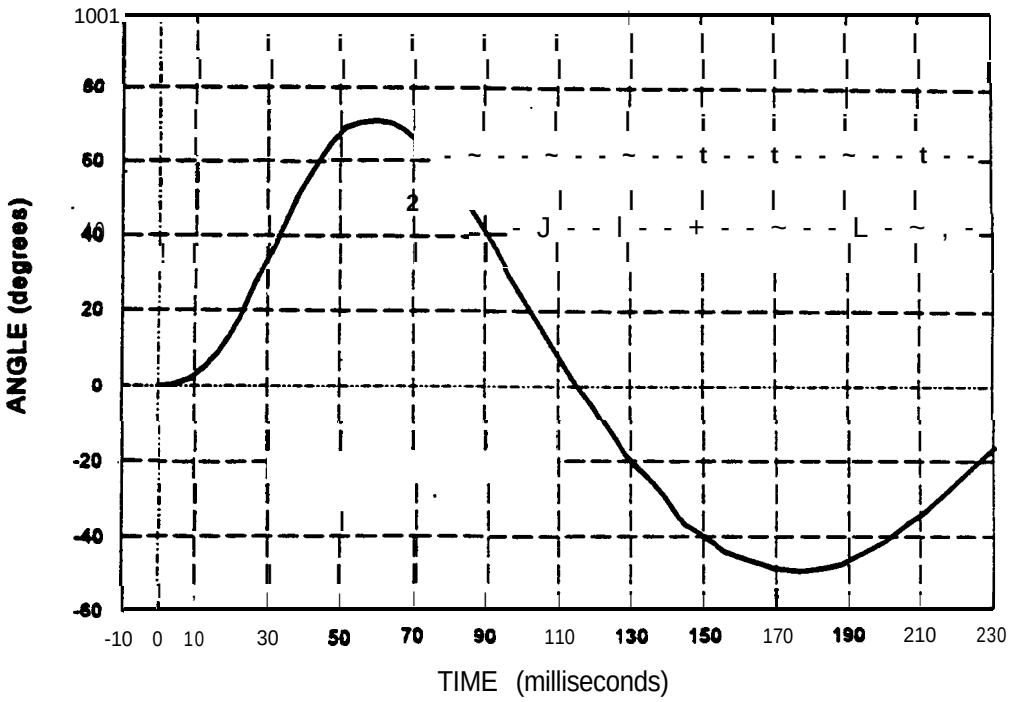


P572-E HYBRID III NECK FLEXION CALIBRATION - ROTATION ABOUT BASE OF NECK

15. **DATA SHEETS (EXAMPLES)....Continued**

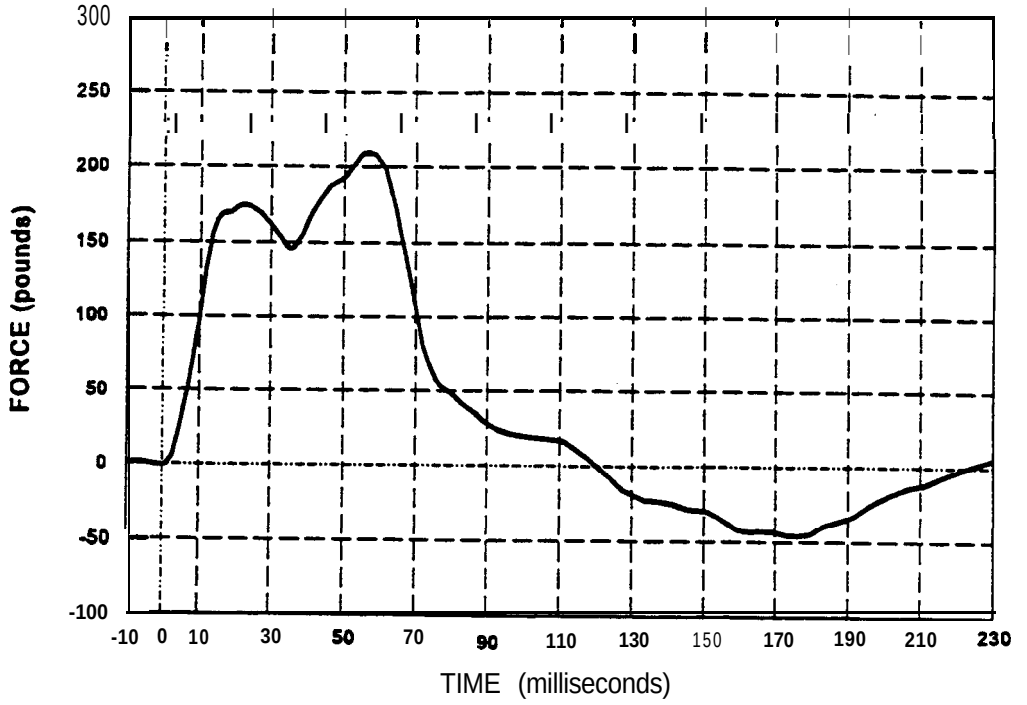


P572-E HYBRID **III** NECK **FLEXION** CALIBRATION - ROTATION ABOUT OCCIPITAL CONDYLE

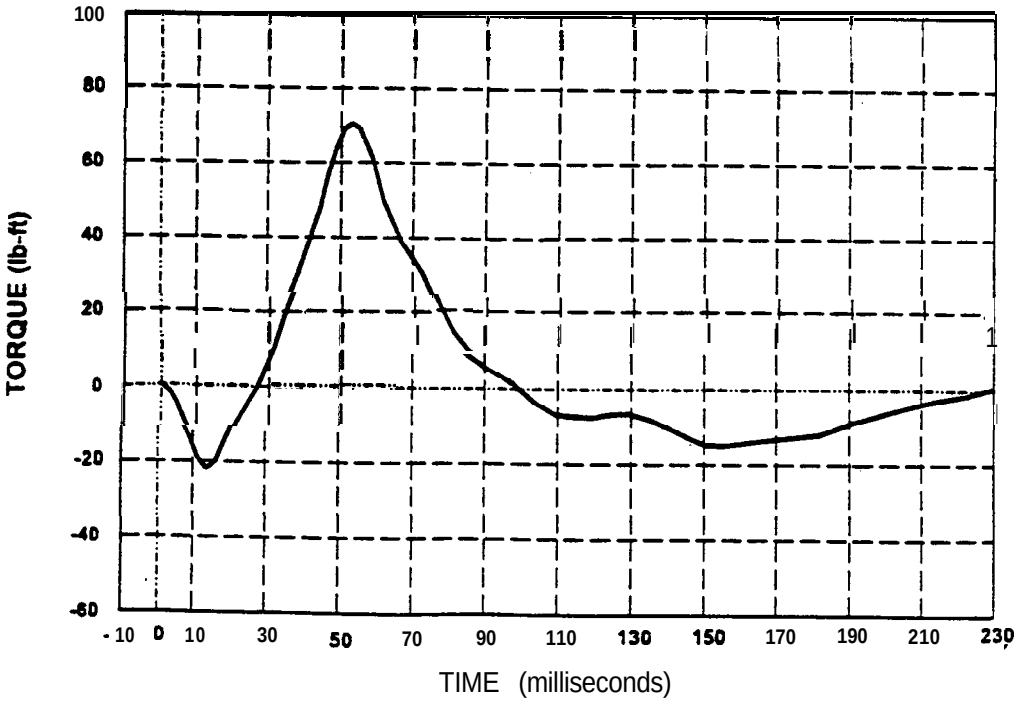


P572-E HYBRID **III** NECK **FLEXION** CALIBRATION -TOTAL ROTATION

15. DATA SHEETS (EXAMPLES). . ..Continued

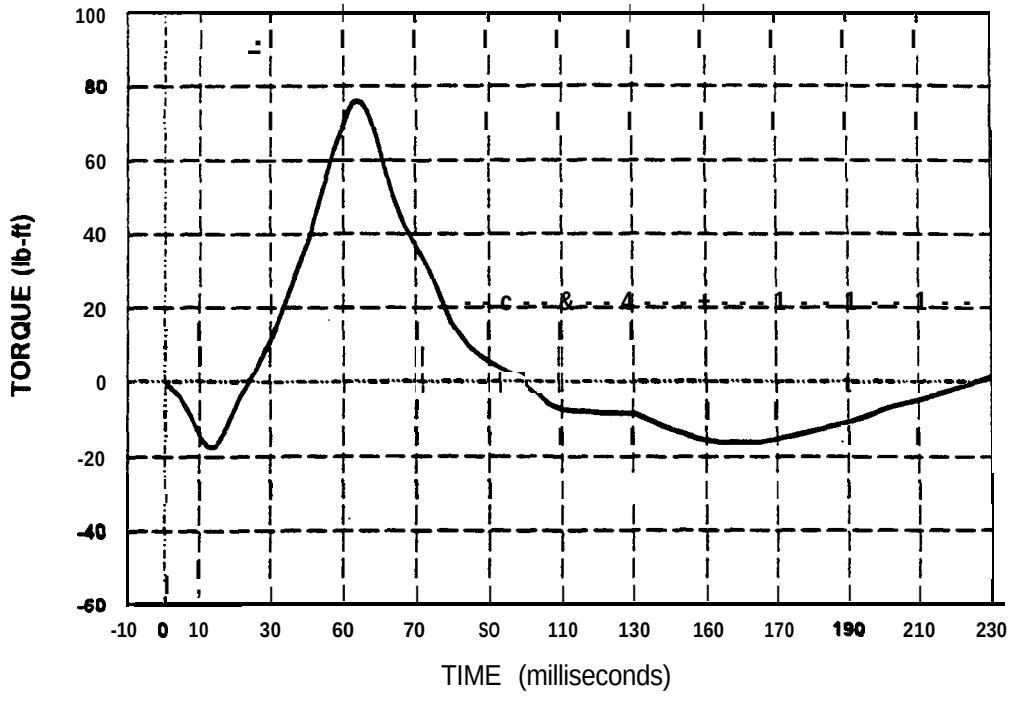


P572-E HYBRID III NECK FLEXION CALIBRATION - NECK FORCE X AXIS



P572-E HYBRID III NECK FLEXION CALIBRATION - NECK MOMENT Y AXIS

15. DATA SHEETS (EXAMPLES)....Continued



P572-E HYBRID III NECK FLEXION CALIBRATION -TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

15. DATA SHEETS (EXAMPLES)....Continued

PART 572E

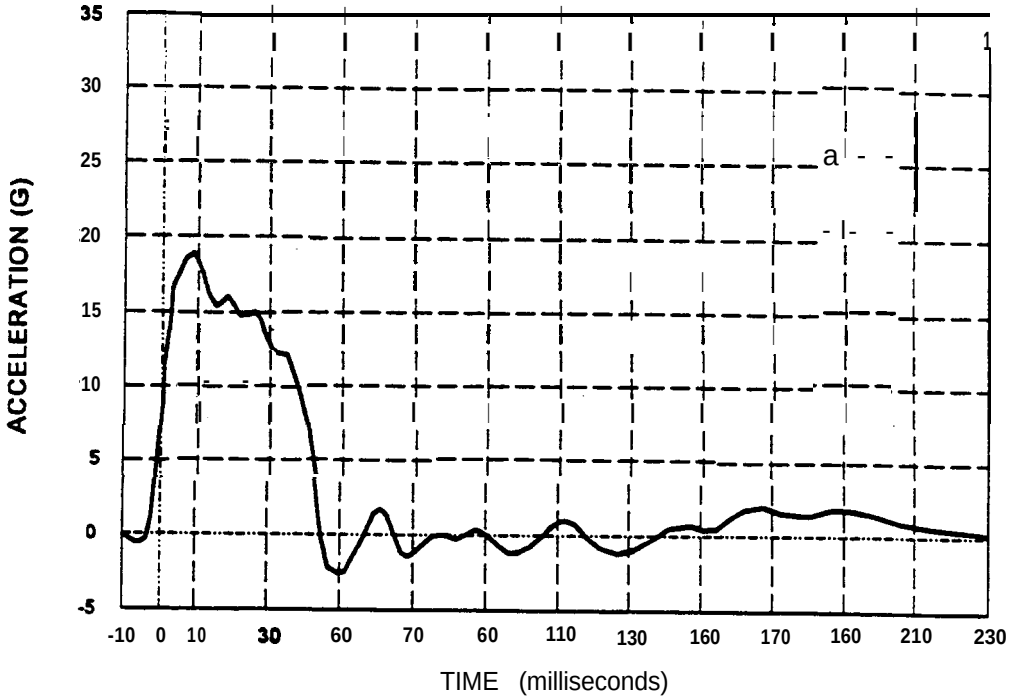
NECK EXTENSION TEST

MANUFACTURER/ID NO.			
CALIBRATION DATE			
TEST PARAMETER		**SPECIFICATION**	**TEST RESULTS**
TEMPERATURE		69°F - 72°F	72°F
RELATIVE HUMIDITY		10% - 70%	49%
IMPACT VELOCITY		19.50 - 20.30 ft/sec	19.67 ft/sec
PENDULUM DECELERATION	10 ms	17.20 Gs - 21.20 Gs	18.03 Gs
	20 ms	14.00 Gs - 19.00 Gs	15.26 Gs
	30 ms	11.00 Gs - 16.00 Gs	12.65 Gs
MAX PENDULUM G ABOVE 30 MS		22 Gs	12.61 Gs
DECELERATION - TIME CURVE DECAY TIME TO 5 G's		38 ms - 46 ms	41.50 ms
D PLANE ROTATION		81°F - 106°F Maximum	90.54°F
		TIME: 72 ms - 82 ms	77.75 ms
MOMENT ABOUT OCCIPITAL CONDYLE		-59.0 - 39.0 ft-lbs Max.	-52.41 ft-lbs
		TIME: 65 ms - 79 ms	71.25 ms
ROTATION ANGLE-TIME CURVE DECAY TIME TO ZERO		147 ms - 174ms	152.75 ms
POSITIVE MOMENT-TIME CURVE DECAY TIME TO ZERO		120 ms - 148ms	134.00 ms

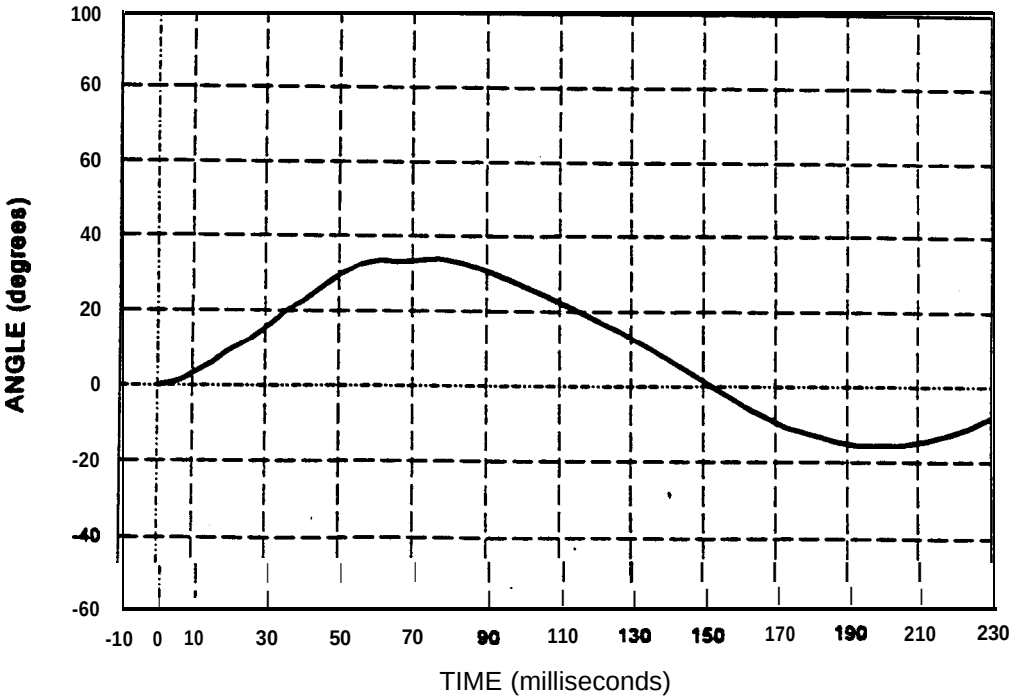
REMARKS:

LABORATORY TECHNICIAN: _____

15. DATA SHEETS **(EXAMPLES)....Continued**

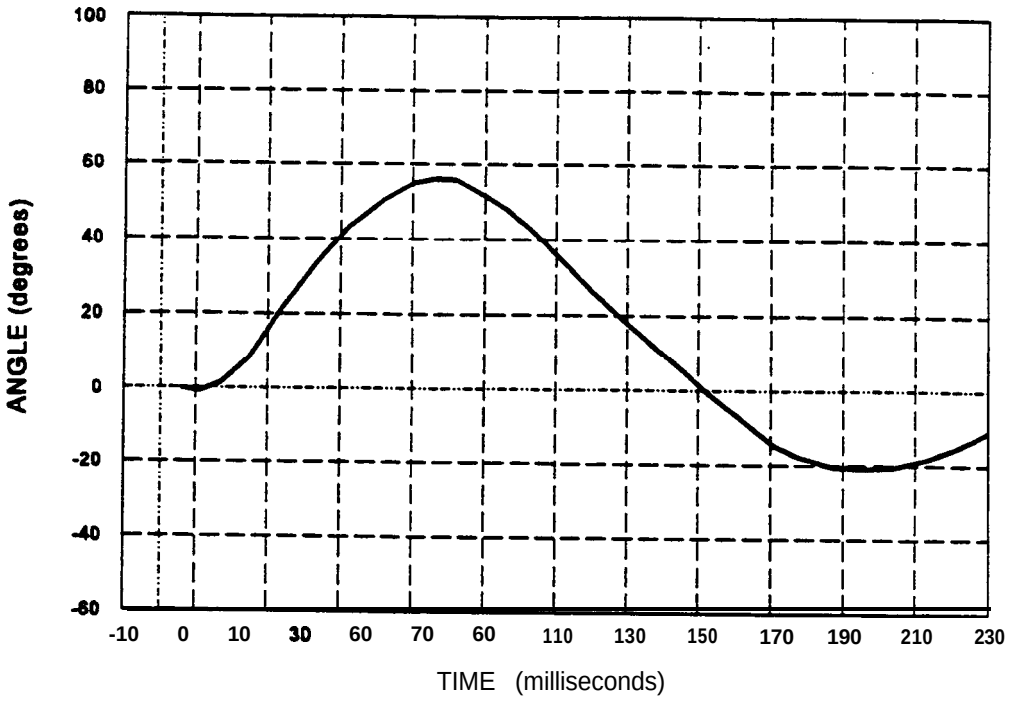


P572-E HYBRID III NECK EXTENSION CALIBRATION - PENDULUM DECELERATION

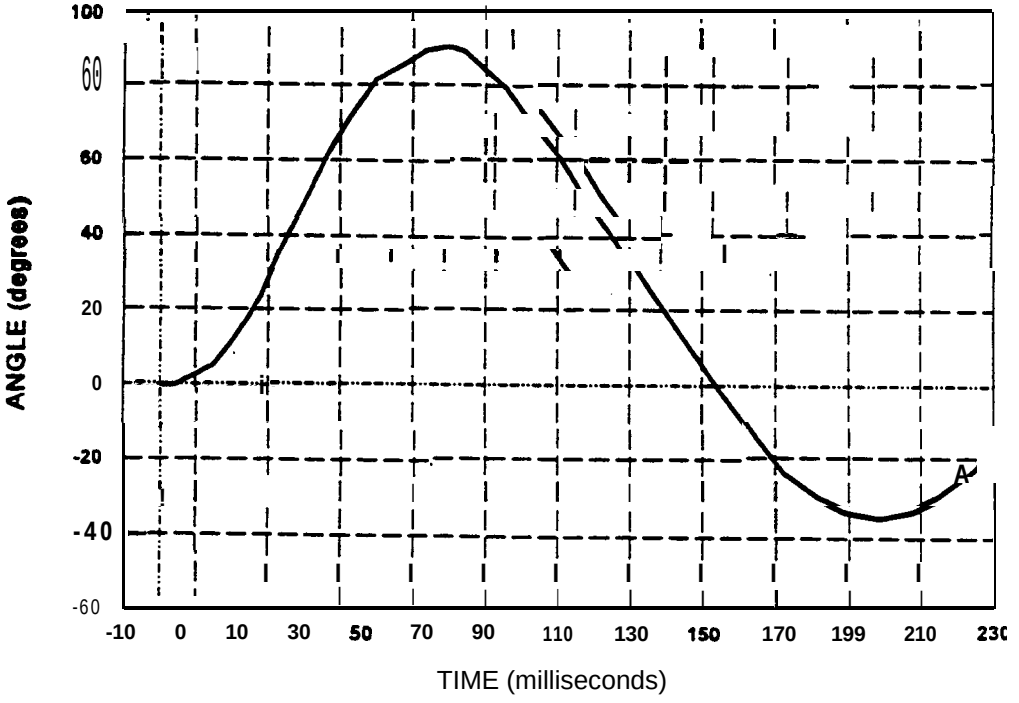


P572-E HYBRID III NECK EXTENSION CALIBRATION - ROTATION ABOUT BASE OF NECK

15. DATA SHEETS (EXAMPLES)....Continued

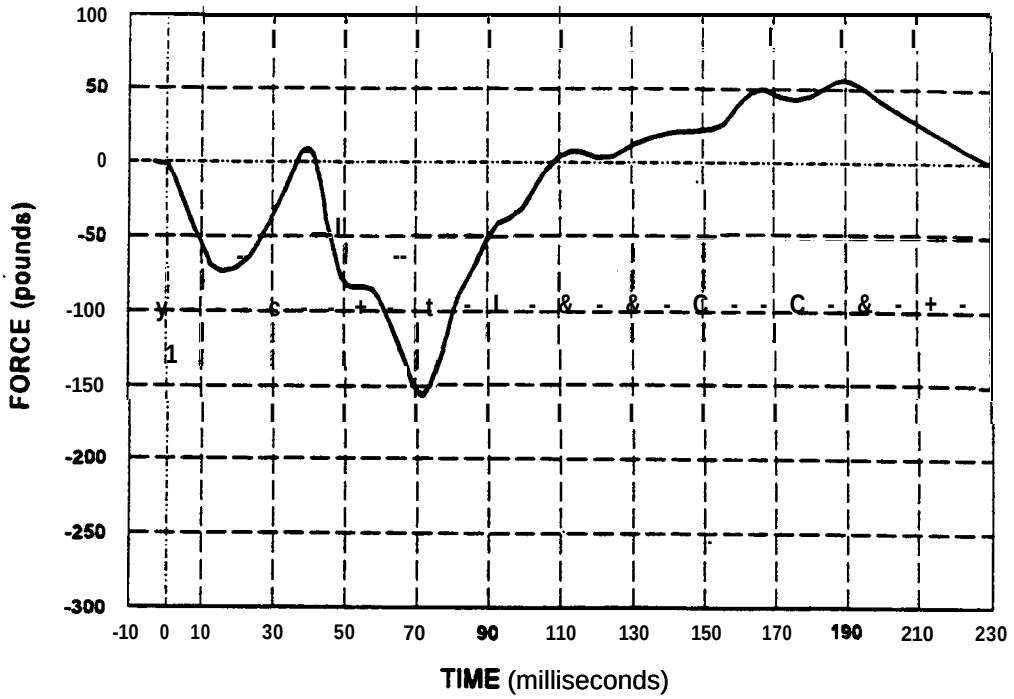


P572-E HYBRID III NECK EXTENSION CALIBRATION - ROTATION ABOUT OCCIPITAL CONDYLE

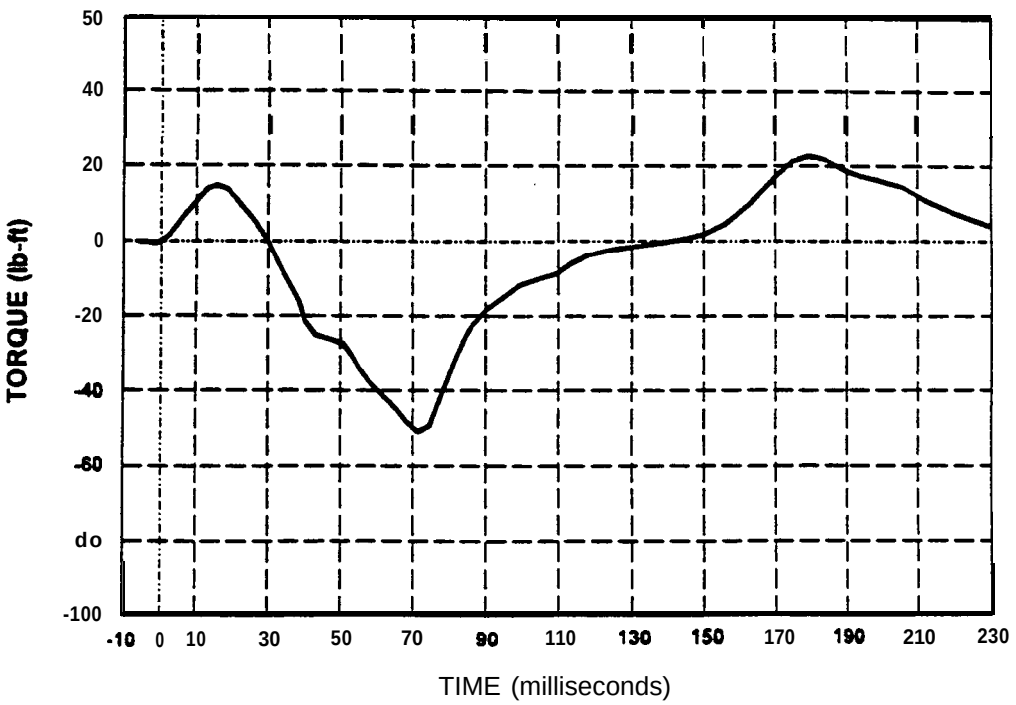


P572-E HYBRID **III** NECK EXTENSION CALIBRATION **- TOTAL** ROTATION

15. DATA SHEETS (EXAMPLES)....Continued

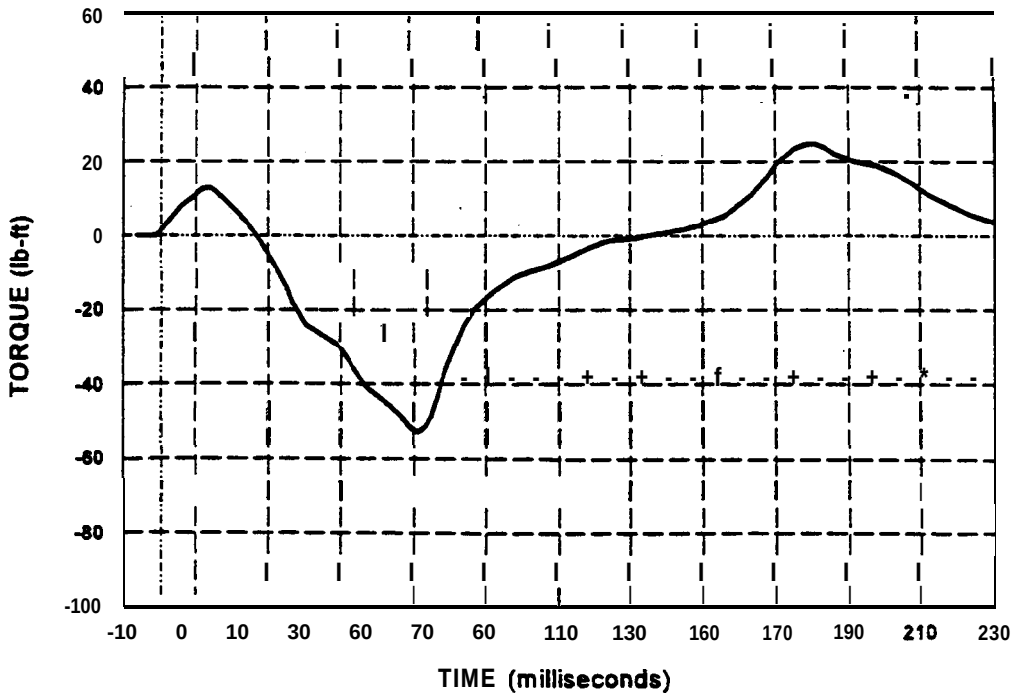


P572-E HYBRID III NECK EXTENSION CALIBRATION - NECK FORCE X AXIS



P572-E HYBRID III NECK EXTENSION CALIBRATION - NECK MOMENT Y AXIS

15. DATA SHEETS (EXAMPLES)....Continued



P572-E HYBRID III NECK EXTENSION CALIBRATION - TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

15. DATA SHEETS (EXAMPLES)....Continued

PART 572E

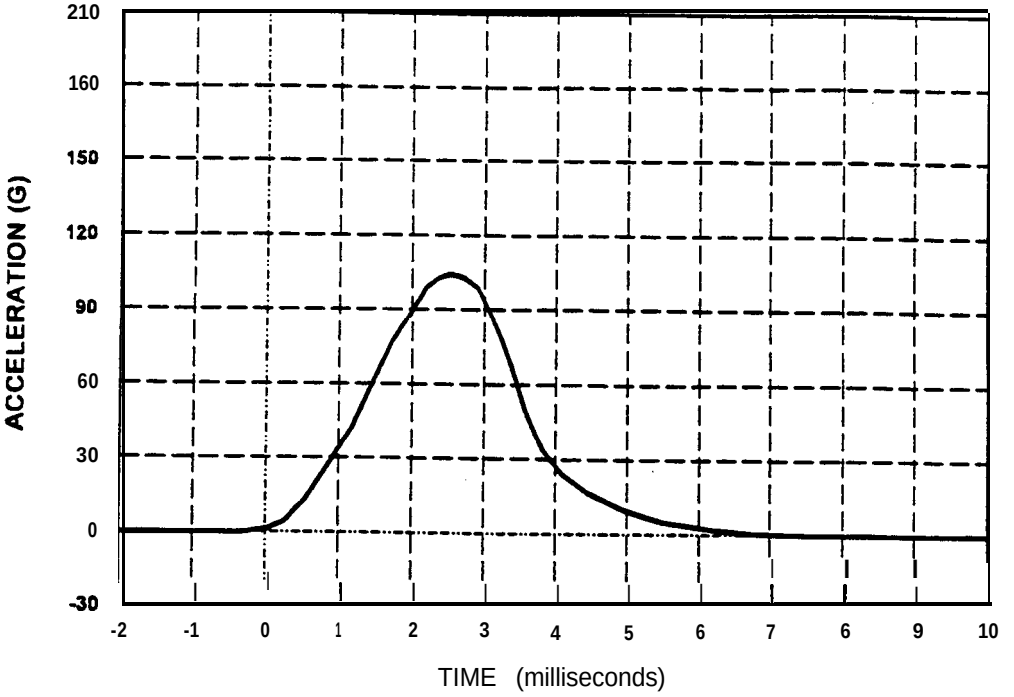
LEFT KNEE IMPACT TEST

MANUFACTURER/ID NO.		
CALIBRATION DATE		
TEST PARAMETER	SPECIFICATION	TEST RESULT
TEMPERATURE	**66°F - 78°F**	72°F
RELATIVE HUMIDITY	**10% - 70%**	**27%**
PROBE VELOCITY	**6.8 - 7.0 ft/sec**	**6.91 ft/sec**
PEAK KNEE IMPACT FORCE	**1060 lbs - 1300 lbs**	**1156.55 lbs**
PROBE WEIGHT	**11 .0 lbs**	

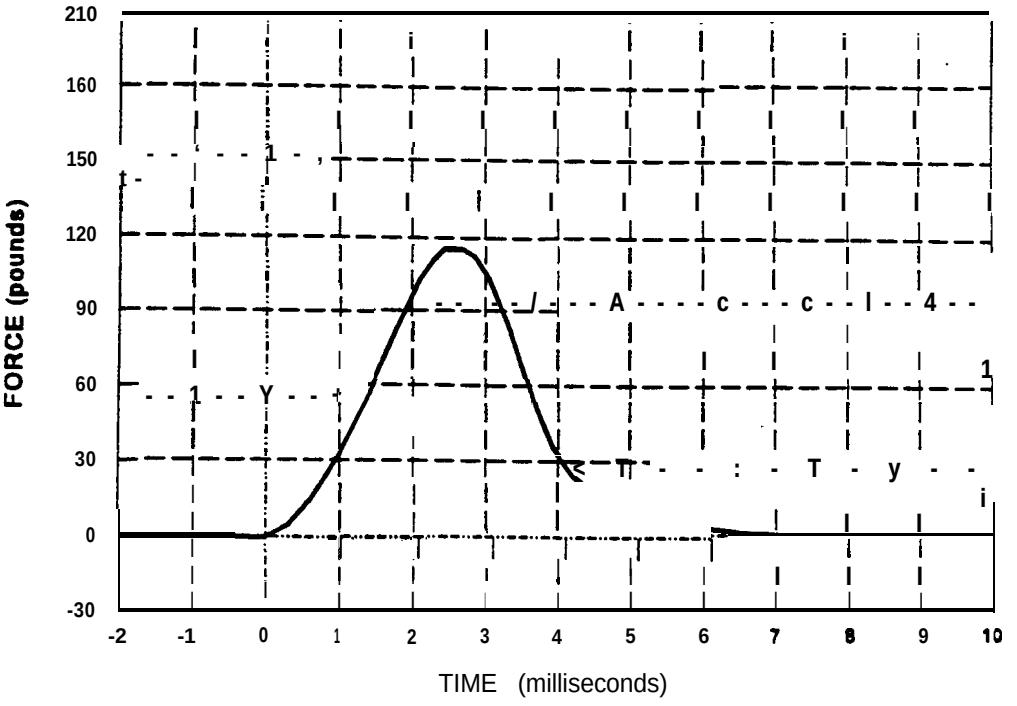
REMARKS:

LABORATORY TECHNICIAN: _____

15. DATA SHEETS (EXAMPLES).. . .Continued



P572-E HYBRID III LEFT KNEE CALIBRATION - PENDULUM DECELERATION (11 LB PEND.)



P572-E HYBRID III LEFT KNEE CALIBRATION - PENDULUM FORCE (11 LB PEND.)

15. **DATA SHEETS** (EXAMPLES). . . .**Continued**

PART 572E

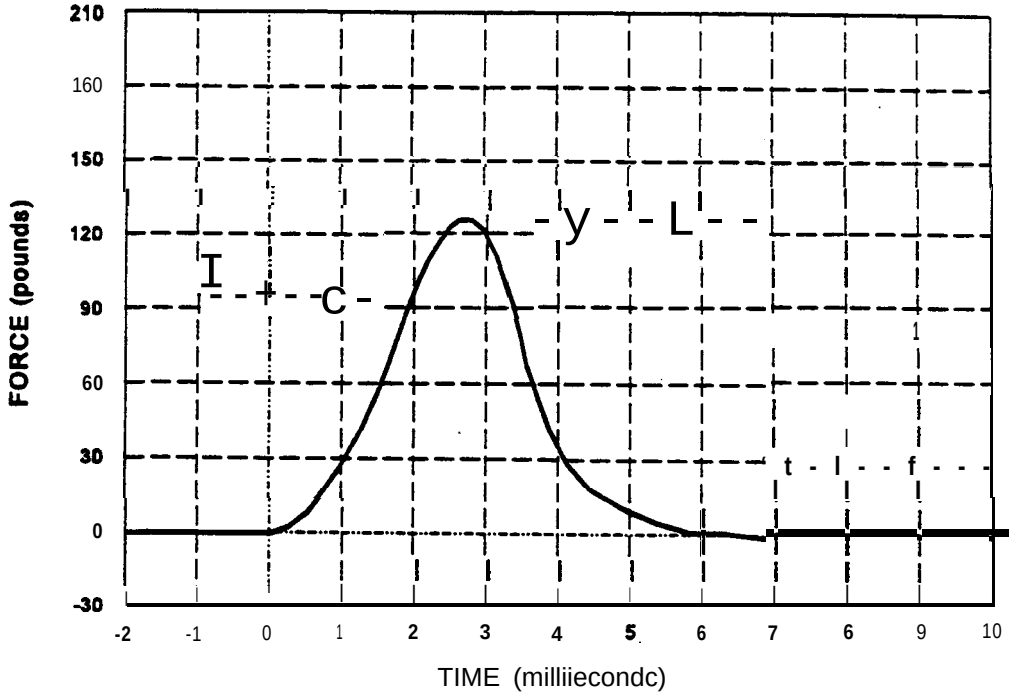
RIGHT KNEE IMPACT TEST

MANUFACTURER/ID NO.		
CALIBRATION DATE		
TEST PARAMETER	**SPECIFICATION**	TEST RESULT
TEMPERATURE	66°F - 78°F	70°F
RELATIVE HUMIDITY	10% - 70%	34%
PROBE VELOCITY	6.8 - 7.0 ft/sec	6.84 ft/sec
PEAK KNEE IMPACT FORCE	1060 lbs - 1300 lbs	1258.57 lbs
PROBE WEIGHT	11.0 lbs	

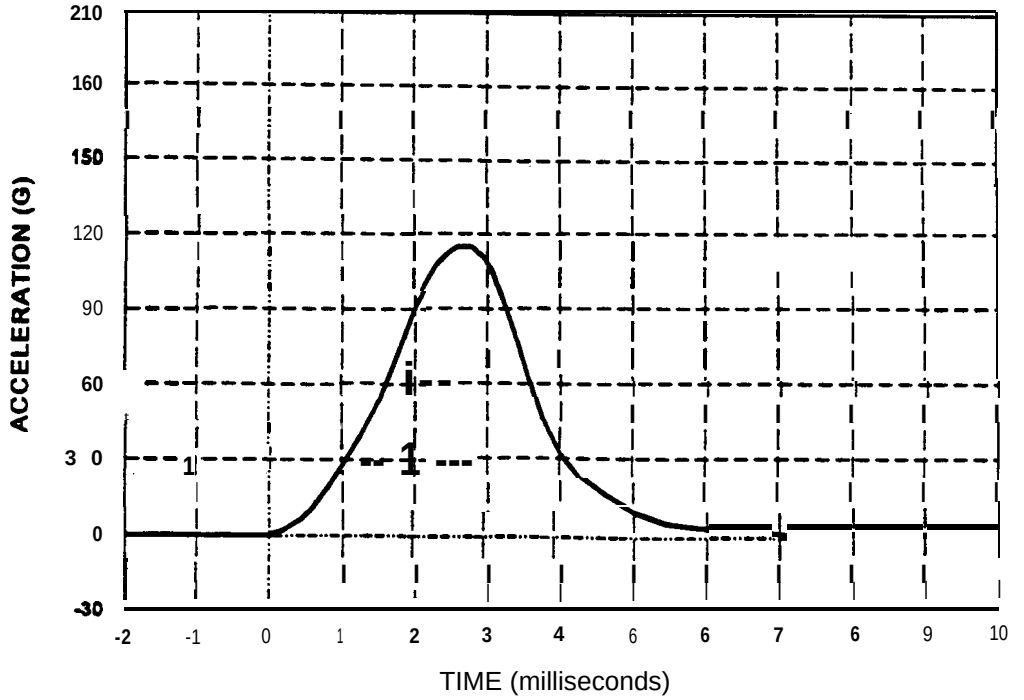
REMARKS:

LABORATORY TECHNICIAN: _____

15. DATA SHEETS (EXAMPLES)....Continued



P572-E HYBRID Ill RIGHT KNEE **CALIBRATION -** PENDULUM FORCE (11 LB PEND.)



P572-E HYBRID III RIGHT KNEE CALIBRATION -PENDULUM DECELERATION (11 LB PEND.)

15. DATA SHEETS (EXAMPLES)....Continued

PART 572E

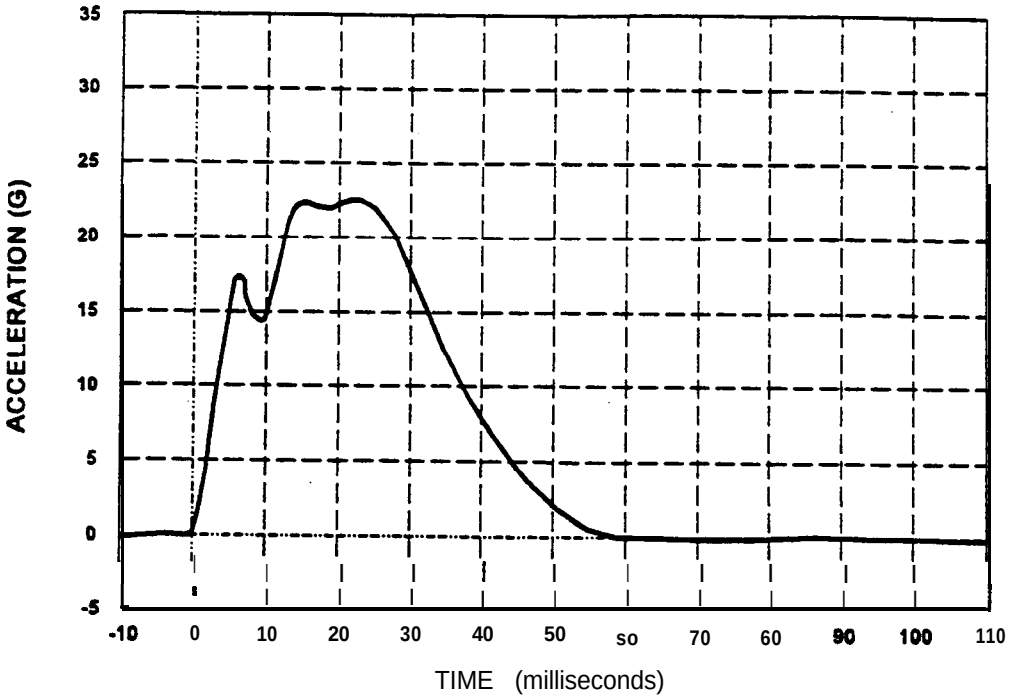
THORAX IMPACT TEST

MANUFACTURER/ID NO.		
CALIBRATION DATE		
TEST PARAMETER	HIGH SPEED TEST SPECIFICATION	TESTRESULTS
TEMPERATURE	69°F - 72°F	72°F
RELATIVE HUMIDITY	10% - 70%	48%
PENDULUM VELOCITY	21.6 - 22.4 ft/sec	21.77 ft/sec
MAXIMUM DEFLECTION	2.50 in - 2.86 in	2.80 in
MAXIMUM RESISTIVE FORCE	1160 lbs - 1325 lbs	1168.0 lbs
INTERNAL HYSTERESIS	69% - 85%	72.00%

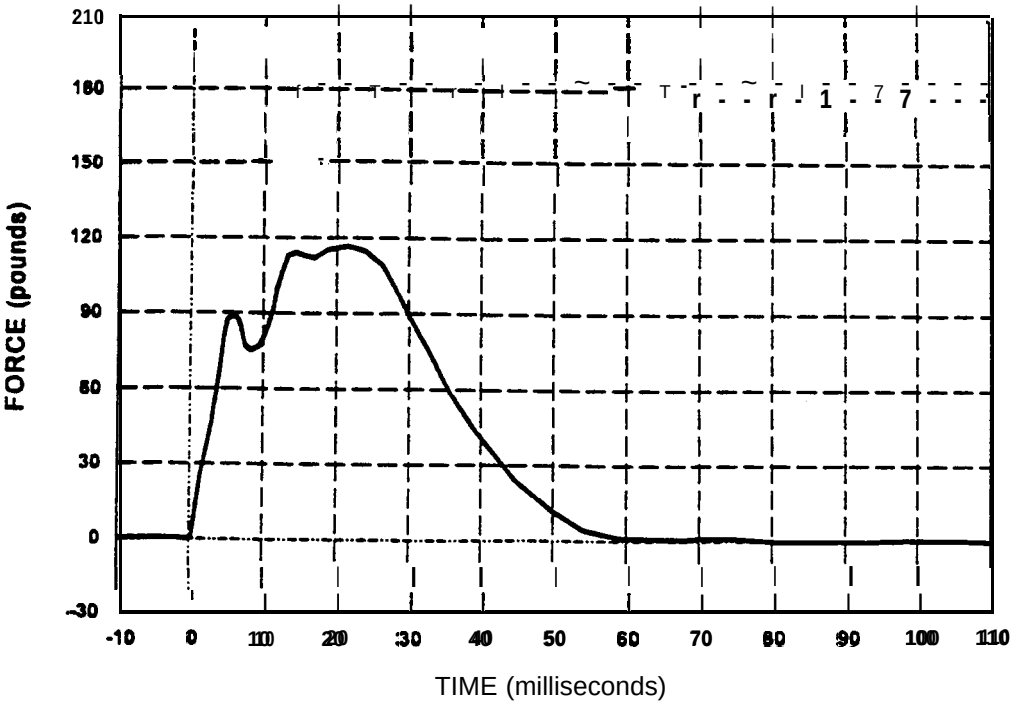
REMARKS:

LABORATORY TECHNICIAN: _____

15. DATA SHEETS (EXAMPLES)....Continued

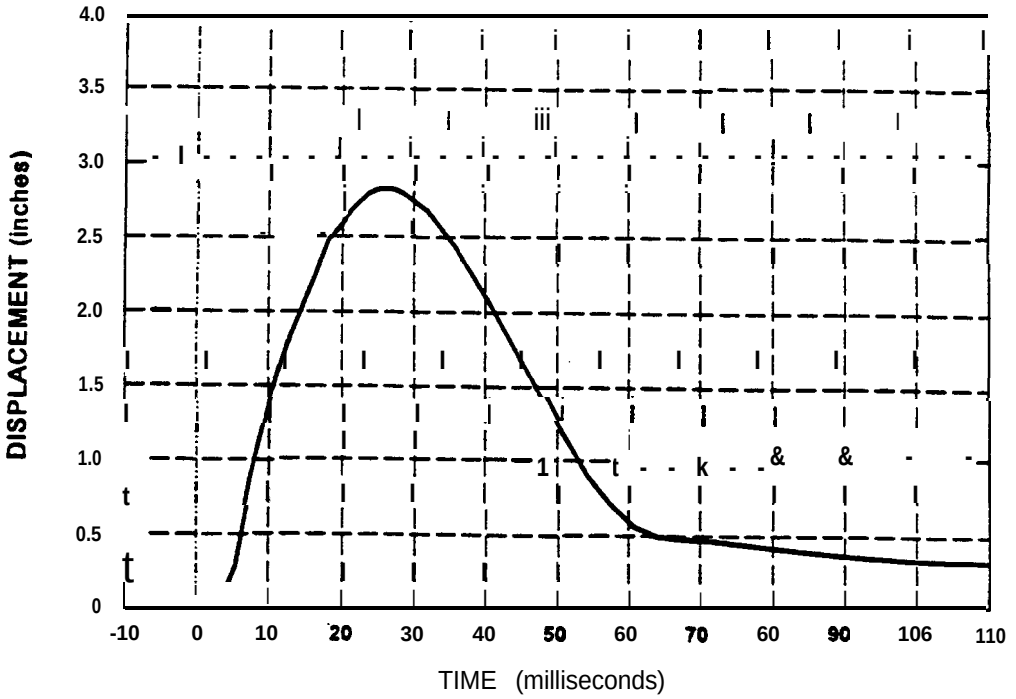


P572-E HYBRID **III** THORAX **CALIBRATION -** PENDULUM DECELERATION

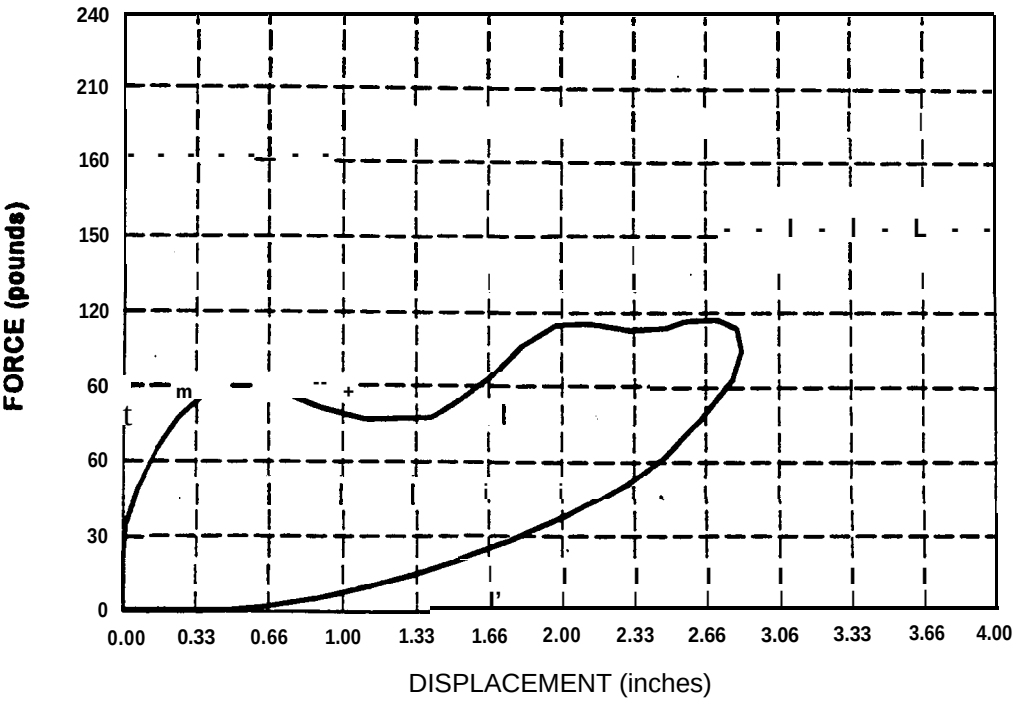


P572-E HYBRID **III THORAX CALIBRATION - PENDULUM FORCE**

15. DATA SHEETS (EXAMPLES)....Continued



P572-E HYBRID III THORAX CALIBRATION - STERNUM DISPLACEMENT



P572-E HYBRID III THORAX CALIBRATION - CHEST DISPLACEMENT VS PENDULUM FORCE

15. DATA SHEETS **(EXAMPLES)....Continued**

PART 572E

DUMMY DAMAGE CHECKLIST

Dummy Serial No.: _____; Project No. _____

OK	Damaged		
		(Begin with general cleaning)	
_____	_____	Outer skin on entire dummy -	Check for gashes, rips, etc.
_____	_____	Head -	Check that ballast is secure
_____	_____		Gashes, rips, general appearance, etc.
_____	_____	Neck -	Broken or cracks in rubber
_____	_____		Check that upper neck bracket is firmly attached to lower neck bracket
_____	_____		Check for looseness at the condyle joint
_____	_____		Nodding blocks - cracked or out of position
_____	_____	Spine -	Broken or cracks in rubber
_____	_____	Ribs -	Check all ribs and rib supports for damage (bent or broken)
_____	_____		Check damping material or separation or cracks
_____	_____		Three rubber bumpers in place
_____	_____	Chest displacement assembly -	Bent shaft - slider arm riding correctly in track
_____	_____	Transducer Leads -	Torn cables
_____	_____	Accelerometer Mountings (head, thorax, pelvis) -	Check for secure mounting
_____	_____	Knees -	Check outer skin, insert and casting (without removing insert)
_____	_____	Limbs -	Check for normal movement and adjustment

_____ _____ Knee sliders -
Wires intact - rubber returned to “at rest” position

_____ _____ Pelvis - , Inspect for breakage, esp. at iliac crest

_____ _____ Other - _____

15. DATA SHEETS (EXAMPLES)....Continued

If upon visual examination, damage is apparent in any of these areas, the appropriate engineer or engineering technician is to be consulted for a decision on repair or replacement of parts.

Repair or Replacement approved by:

_____ _____

Signature **Date**

COMMENTS ON REPAIR OR REPLACEMENT OF PARTS:

Checked by:

_____ _____

Signature Date

15. DATA SHEETS (EXAMPLES). . .**Continued**

PART 572E

SAMPLE INSTRUMENTATION CALIBRATION INFORMATION

I.D. NO.	MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF LAST CALIBRATION	DATE OF NEXT CALIBRATION
HEAD ACCELEROMETERS					
(1) LONGITUDINAL	ENDEVCO	7231 C-750	CG21		
(2) LATERAL	ENDEVCO	7231 C-750	CD74		
(3) VERTICAL	ENDEVCO	7231 C-750	CE23		
NECK TRANSDUCER	GSE	188007-0100	182		
CHEST ACCELEROMETERS					
(1) LONGITUDINAL	ENDEVCO	7231C-750			
(2) LATERAL	ENDEVCO	7231C-750			
(3) VERTICAL	ENDEVCO	7231C-750			
CHEST POTENTIOMETER	VERNITECH	81422	85427-29		
FEMUR LOAD CELLS					
(1) RIGHT FEMUR	GSE	2430			
(2) LEFT FEMUR	GSE	2430			
LABORATORY INSTRUMENTATION					
NECK PENDULUM ACCELEROMETER	ENDEVCO	7232C-750	cc59		
THORAX PENDULUM ACCELEROMETER	ENDEVCO	7231 C-750	CG83		
KNEE PENDULUM ACCELEROMETER	ENDEVCO	7 2 8 4 2 0 0 0	CH15H		
NECK ROTATION TRANSDUCER 1 (OPTIONAL)	BOURNS	35435-001-102			
NECK ROTATION TRANSDUCER 2 (OPTIONAL)	BOURNS	35435-001-102			

15. **DATA SHEETS (EXAMPLES)....Continued**

PART 572E

SAMPLE INSTRUMENTATION CALIBRATION INFORMATION

I.D. NO.	MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF LAST CALIBRATION	DATE OF NEXT CALIBRATION
HEAD ACCELEROMETERS - REDUNDANT					
(1) LONGITUDINAL	ENDEVCO	7231 C-750	CG21		
(2) LATERAL	ENDEVCO	7231 C-750	CD74		
(3) VERTICAL	ENDEVCO	7231 C-750	CE23		
CHEST ACCELEROMETERS - REDUNDANT					
(1) LONGITUDINAL	ENDEVCO	7231 C-750			
(2) LATERAL	ENDEVCO	7231 C-750			
(3) VERTICAL	ENDEVCO	7231 C-750			
PELVIC ACCELEROMETERS					
(1) LONGITUDINAL	ENDEVCO				
(2) LATERAL	ENDEVCO				
(3) VERTICAL	ENDEVCO				
TIBIA INSTRUMENTATION					
TIBIA MOMENTS LEFT					
TIBIA FORCES LEFT					
TIBIA MOMENTS RIGHT					
TIBIA FORCES RIGHT					

FOOT ACCELEROMETERS

Longitudinal					
Lateral					
Vertical					

SAMPLE INSTRUMENTATION **CALIBRATION** INFORMATION

BELT INSTRUMENTATION					
I.D. NO.	MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF LAST CALIBRATION	DATE OF NEXT CALIBRATION
TORSO BELT LOAD CELL					
LAP BELT LOAD CELL					
BELT SPOOL-OUT POTENTIOMETER					
BELT STRETCH TRANSDUCER					

VEHICLE ACCELEROMETERS					
LEFT REAR X-MEMBER					
RIGHT REAR X-MEMBER					
ENGINE TOP					
ENGINE BOTTOM					
LEFT DISC BRAKE CALIPER					
RIGHT DISC BRAKE CALIPER					
INSTRUMENT PANEL					
REDUNDANT LEFT REAR X-MEMBER					
REDUNDANT RIGHT REAR X-MEMBER					

LABORATORY TECHNICIAN: _____

APPENDIX B

DUMMY POSITIONING PROCEDURES FOR TEST DUMMY CONFORMING TO SUBPART E OF PART 572

DUMMY PLACEMENT

1. HEAD

The transverse instrumentation platform of the head shall be horizontal within 0.5". To level the head of the test dummy, the following sequences must be followed. First adjust the position of the H point within the limits set forth in Section 4.B(1) If the transverse instrumentation platform of the head is still not level, then adjust the pelvic angle of the test dummy within the limits provided in Section 4.B(2). If the transverse instrumentation platform of the head is still not level, adjust the neck bracket of the test dummy the minimum amount necessary from the nonadjusted "0" setting to ensure that the transverse instrumentation platform of the head is horizontal within 0.5". The test dummy shall remain within the limits specified for the H-point and pelvic angle after any adjustment of the neck bracket. (S11.1)

2. ARMS

A. Driver

The driver's upper arms shall be adjacent to the torso with the centerlines as close to a vertical plane as possible. (S11.2.1)

B. Passenger

The passenger's upper arms shall be in contact with the seat back and the sides of the torso. (S11.2.2)

3: HANDS

A. Driver

The palms of the driver test dummy shall be in contact with the outer part of the steering wheel rim at the rim's horizontal centerline. The thumbs shall be over the'steering wheel rim and shall be lightly taped to the steering rim so that if the hand of the test dummy is pushed upward by a force of not less than 2 pounds and not more than 5 pounds, the tape shall release the hand from the steering wheel rim. (S11.3.1)

B. Passenger

The palms of the passenger test dummy shall be in contact with the outside of the thigh. The little finger shall be in contact with the seat cushion.

DUMMY PLACEMENT....Continued

4. **TORSO**

A. Upper Torso

(1) Bench Seats

In vehicles equipped with bench seats, the upper torso of the driver and passenger test dummies shall rest against the seat back. The midsagittal plane of the driver dummy shall be vertical and parallel to the vehicles longitudinal centerline, and pass through the center of the steering wheel rim. The midsagittal plane of the passenger dummy shall be vertical and parallel to the vehicle's longitudinal centerline and the same distance from the vehicle's longitudinal centerline as the midsagittal plane of the driver dummy. (S11.4.1)

(2) Bucket Seats

In vehicles equipped with bucket seats, the upper torso of the driver and passenger test dummies shall rest against the seat back. The midsagittal plane of the driver and the passenger dummy shall be vertical and shall coincide with the longitudinal centerline of the bucket seat. (S11.4.2)

(3) Split Bench Seats

In vehicles equipped with split bench seats, the dummies will be placed as specified by the vehicle manufacturer.

B. Lower Torso

(1) H-Point. The H-point of the driver and passenger test dummies shall coincide within 0.5 inch in the vertical dimension and 0.5 inch in the horizontal dimension of a point 0.25 inch below the position of the H point determined by using the equipment and procedures specified in SAE J826 (Apr 80) **[APPENDIX H]** except that the length of the lower leg and thigh segments of the H-point machine shall be adjusted to 16.3 and 15.8 inches respectively, instead of the 50th percentile values specified in Table 1 of SAE J826. (S11.4.3.1)

(2) Pelvic Angle. As determined using the pelvic angle gage (GM drawing 78051-532 incorporated by reference in Part 572, Subpart E) which is inserted into the H-point gaging hole of the dummy, the angle measured from the horizontal on the 3 inch flat surface of the gage shall be 22.5 degrees ± 2.50 degrees. (S11.4.3.2)

DUMMY PLACEMENT.. . .Continued

5. LEGS

The upper legs of the driver and passenger test dummies shall rest against the seat cushion to the extent permitted by placement of the feet. The initial distance between the outboard knee clevis flange surfaces shall be 10.6 inches. To the extent practicable, the left leg of the driver dummy and both legs of the passenger dummy shall be in vertical longitudinal planes. To the extent practicable, the right leg of the driver dummy shall be in a vertical plane. Final adjustment to accommodate placement of feet in accordance with Section 6 for various passenger compartment configurations is permitted. (S1 1.5.2)

6. FEET

A. Driver Feet Placement

Rest the right foot of the test dummy on the undepressed accelerator pedal with the rearmost point of the heel on the floor pan in the plane of the pedal. If the foot cannot be placed on the accelerator pedal, set it initially perpendicular to the lower leg and place it as far forward as possible in the direction of the pedal centerline with the rearmost point of the heel resting on the floor pan. Except as prevented by contact with a vehicle surface, place the right leg so that the upper and lower leg centerlines fail, as close as possible, in a vertical plane without inducing torso movement. (S1 1.6, S10.1.1(b))

Place the left foot on the toeboard with the rearmost point of the heel resting on the floor pan as close as possible to the point of intersection of the planes described by the toeboard and the floor pan and not on the wheelwell projection. If the foot cannot be positioned on the toeboard, set it initially perpendicular to the lower leg and place it as far forward as possible with the heel resting on the floor pan. If necessary to avoid contact with the vehicle's brake or clutch pedal, rotate the test dummy's left foot about the lower leg. If there is still pedal interference, rotate the left leg outboard about the hip the minimum distance necessary to avoid the pedal interference. Except as prevented by contact with a vehicle surface, place the left leg so that the upper and lower leg centerlines fall, as close as possible, in a vertical plane. For vehicles with a foot rest that does not elevate the left foot above the level of the right foot, place the left foot on the foot rest so that the upper and lower leg centerlines fall in a vertical plane. (S1 1.6, S10.1.1(c))

B. Passenger Feet Placement

(1) Flat floor pan/toeboard:

Place the right and left feet on the vehicle's toeboard with the heels resting on the floor pan as close as possible to the intersection point

DUMMY PLACEMENT....Continued

with the toeboard. If the feet cannot be placed flat on the toeboard, set them perpendicular to the lower leg centerlines and place them as far forward as possible with the heels resting on the floor pan. 611.6, S10.1.2.1(b))

Place the right and left legs so that the upper and lower leg centerlines fall in vertical longitudinal planes. **611.6, S1** 0.1.2.1 (c))

(2) Wheelhouse projections:

Place the right and left feet in the well of the floor pan/toeboard and not on the wheelhouse projection. If the feet cannot be placed flat on the toeboard, initially set them perpendicular to the lower leg centerlines and then place them as far forward as possible with the heels resting on the floor pan. **(S11.6, S10.1.2.2(b))**

If it is not possible to maintain vertical and longitudinal planes through the upper and lower leg centerlines for each leg, then place the left leg so that its upper and lower centerlines fall, as closely as possible, in a vertical longitudinal plane and place the right leg so that its upper and lower leg centerlines fall, as closely as possible, in a vertical plane. (S11.6, S1 0. 1.2.2(c))

DUMMY PLACEMENT.. ..Continued

TABLE 1C - DUMMY POSITION

P572E	DRIVER DSP	PASSENGER DSP
UPPER TORSO	BENCH SEAT: Placed against seat back. Midsagittal plane is vertical & parallel to vehicle C/L passing thru center of steering wheel rim. NOTE: Split bench seat - as in manufacturer's certification test(s).	BENCH SEAT: Placed against seat back. Midsagittal plane is vertical and longitudinal located the same distance from the vehicle longitudinal C/L as the midsagital plane of the driver dummy. NOTE: Split bench seat - as in manufacturer's certification test(s).
	BUCKET SEAT: Placed against seat back. Midsagittal plane is vertical and parallel to C/L of the seat cushion.	BUCKET SEAT: Placed against seat back. Midsagittal plane is vertical and parallel to C/L of the seat cushion.
UPPER ARMS	Initially placed against seat back & tangent to side of upper torso. Push arms rearward into the seat back with bending at elbows.	Initially placed against seat back & tangent to side of upper torso. Push arms rearward into seat back with bending at elbows. Remains tangent.
LOWER ARMS	Initially placed against the outside of the thighs. C/L as close as possible in a vertical plane.	Initially placed against the outside of the thighs. C/L as close as possible in a vertical plane.
HAND PALMS	Palms contact outer part of steering wheel rim at horizontal CA.	Palms contact the outside of the thighs.
HAND THUMBS	Placed over steering wheel rim	
HAND LITTLE FINGERS		Barely in contact with the seat cushion.
LOWER TORSO	H-point shall coincide within 0.50 inch in the vertical and horizontal dimension of a point 0.25 inch below the position established by the SAE JB26 (APR 80) with thigh/leg segments adjusted to 16.3/15.8 inches. Pelvic angle shall be 22.50 ± 0.50 degrees.	H-point shall coincide within 0.50 inch in the vertical and horizontal dimension of a point 0.25 inch below the position established by the SAE J826 (APR 80) with thigh/leg segments adjusted to 16.3/15.8 inches. Pelvic angle shall be 22.50 ± 0.50 degrees.
UPPER LEGS	Placed against seat cushion. Plane defined by femur & tibia C/Ls is as close as possible to vertical.	Placed against seat cushion. Located so that plane defined by femur & tibia C/Ls is as close as possible to vertical/longitudinal for left leg, vertical for right leg.
KNEES	Initially set 10.6 inches apart between outboard knee clevis flange.	Initially set 10.6 inches apart between outboard knee clevis flange.
LOWER LEGS	Plane defined by upper and lower leg C/Ls as close as possible to vertical plane.	Plane defined by upper and lower leg C/Ls is as close as possible to vertical, longitudinal plane.
RIGHT FOOT	Placed on undepressed accelerator pedal. Rearmost point of heal on floorpan in plane of pedal.	Place on toeboard rearmost point of heel on floorpan as close as possible to intersection of toeboard & floor pan.
LEFT FOOT	Raced on toeboard. Rearmost point of heed on floorpan as close as possible to intersection of toeboard & floor pan. CA falls in vertical longitudinal plane.	Place on toeboard rearmost point of heel on floorpan as close as possible to intersection of toeboard & floor pan.

DUMMY PLACEMENT....Continued

7. INTENTIONALLY BLANK

8. INTENTIONALLY BLANK

9. **MANUAL BELT ADJUSTMENT FOR DYNAMIC TESTING**

The seats shall be positioned as specified for the impact test (NCAPTP090196). Position the test dummy in the vehicle in accordance with the requirements specified in Section 1 through Section 6, above, in its designated seating position.

Place the Type 2 manual belt around the test dummy and fasten the latch. Remove all slack from the lap belt. Pull the upper torso webbing out of the retractor and allow it to retract; repeat this operation four times. Apply a 2 pound to 4 poundtension load to the lap belt. If the belt system is equipped with a tension-relieving device introduce the maximum amount of slack into the upper torso belt that is recommended by the manufacturer for normal use in the owners manual for the vehicle. If the belt system is not equipped with a tension-relieving device, allow the excess webbing in the shoulder belt to be retracted by the retractive force of the retractor. (S1 1.9)

APPENDIX C

REDUNDANT HEAD AND CHEST ACCELEROMETERS - (RECOMMENDED PRACTICE)

The following guideline is intended to serve only as an interim measure for use in affixing the redundant accelerometers in the head and chest of the Hybrid III dummies. Standard procedures for obtaining redundant data are currently being developed. the contractor is expected to closely follow this guideline until such standard procedures are available. contact the COTR if difficulty arises in meeting the guideline, or more details are needed.

1. The locations of the primary accelerometers (either head or chest), as specified in the test procedure, shall not be altered as a result of installing the redundant accelerometer set. In addition, the center of gravity (C.G.) of the head or chest with the redundant accelerometers installed shall stay within the allowable range as indicated in the Hybrid III specification.

2. The weight increase due to installation of the redundant accelerometers in the head and chest shall be within the allowable weight variation specified for the head and chest in the Hybrid III drawing documentation.

3. To simplify and facilitate the installation, the following recommendations are provided:

A. Use of ENDEVCO 72642000 accelerometers and existing mounting fixtures is desirable because of the light weight of the ENDEVCO 7264's (ENDEVCO 7264 weighs 1 gram whereas the ENDEVCO 7231c weighs 24 grams.

B. Redundant accelerometer 7264 can be attached directly to the primary one, either head -to-head or back-to-back, and then attach both to one side of the mounting cube.

C. Use of spacers between the primary and redundant accelerometers is recommended for better stability. Spacers shall be made of aluminum due to weight considerations.

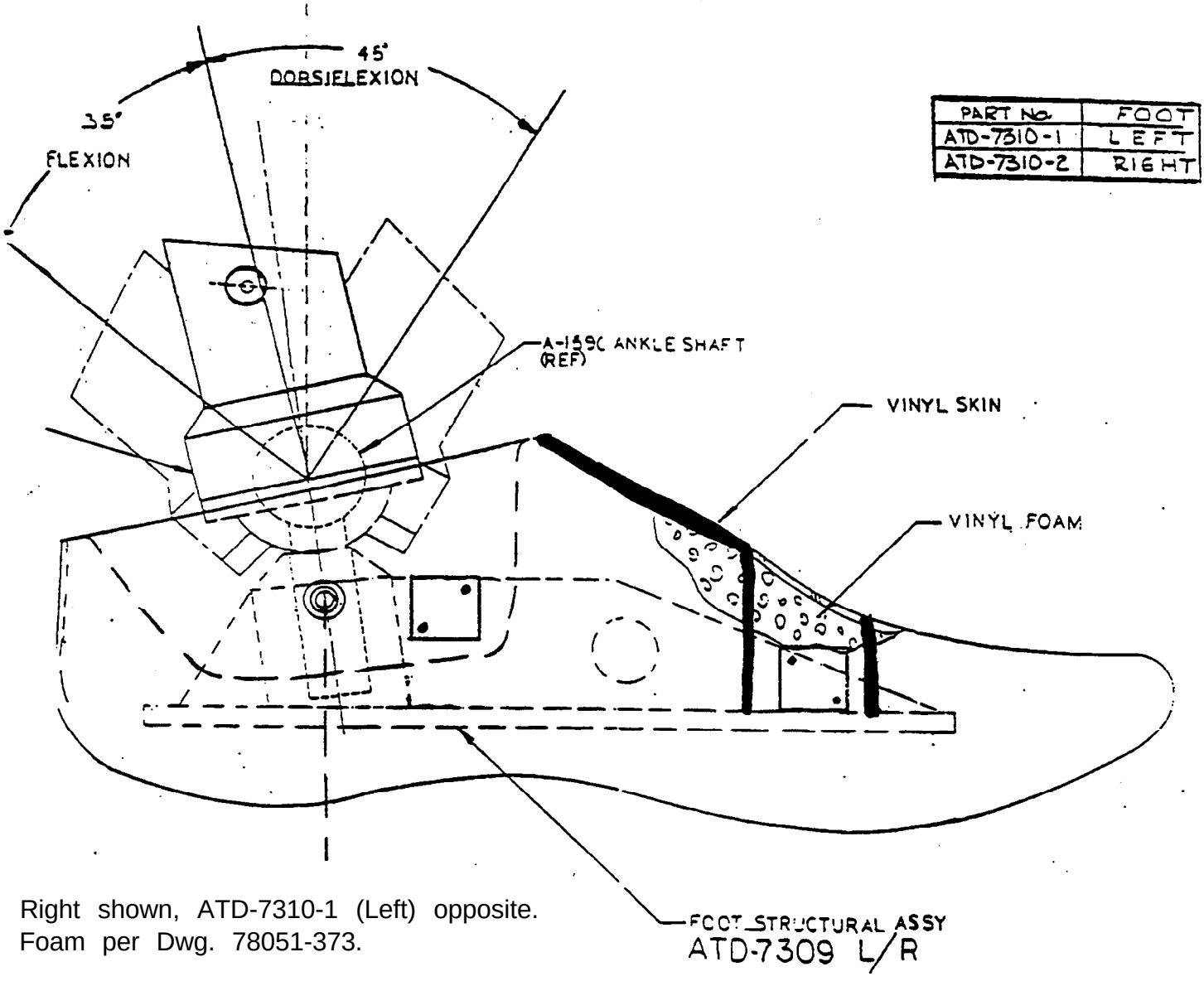
4. The injury criterion values (HIC and Chest Clip) generated by using the redundant data sets shall not deviate more than ten (10) percent from their respective primary injury criterion values.

APPENDIX D

RECOMMENDED PRACTICE - HYBRID III FOOT INSTRUMENTATION

The Hybrid III Driver and Passenger feet are instrumented to measure acceleration in the X, Y, Z axis for both the outboard ankle and toe regions as shown in the following diagrams. A triaxial cube with Endevco model 7264 accelerometers is used. The design is easily adapted to the proposed 45 degree ankle.

Easily Adapted to Proposed 45 degree ankle



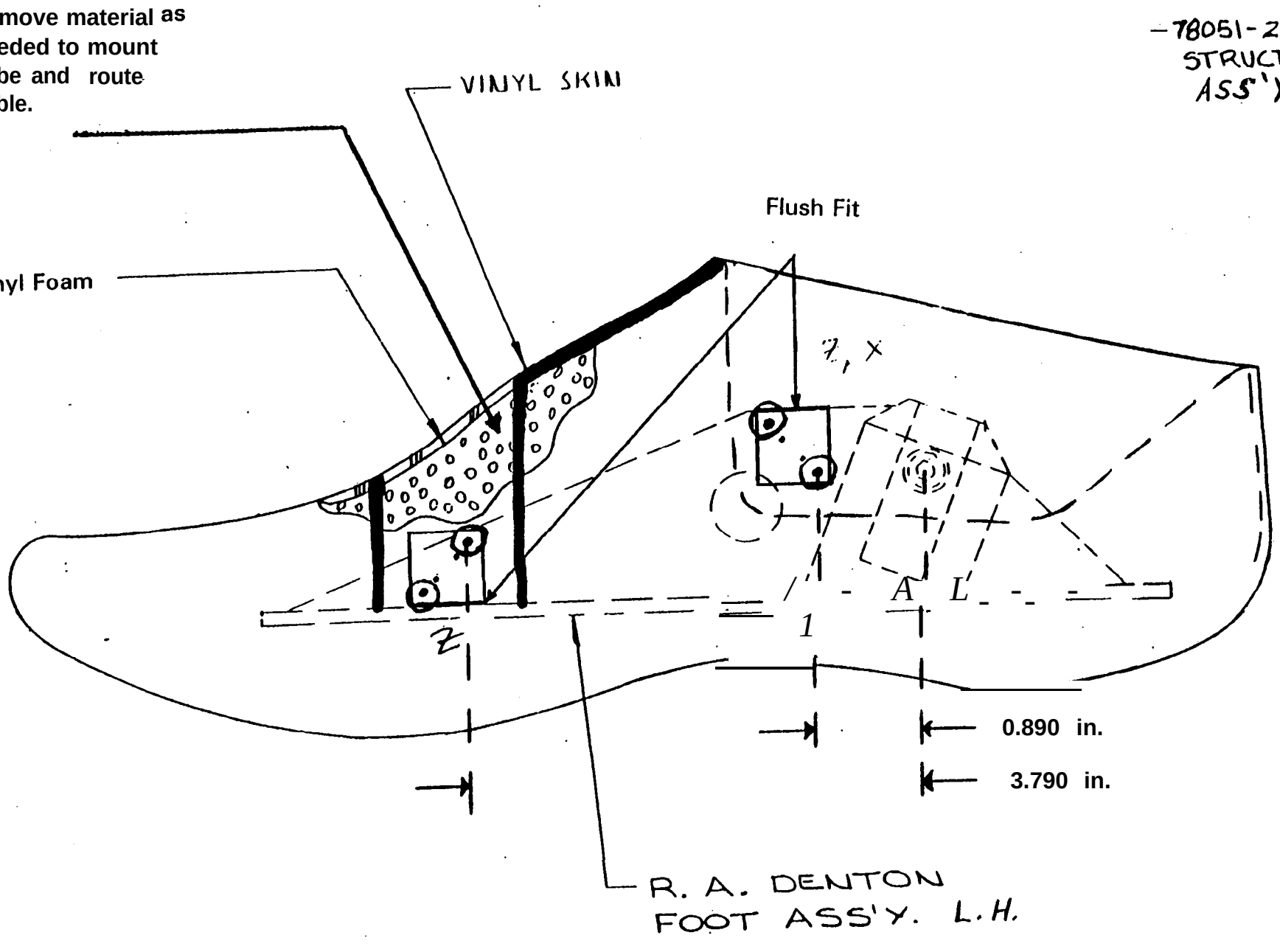
PART No	FOOT
ATD-7310-1	LEFT
ATD-7310-2	RIGHT

Right shown, ATD-7310-1 (Left) opposite.
Foam per Dwg. 78051-373.

Skin.
Model 78051-284(L) & -285 (R) within ± 0.02 in.

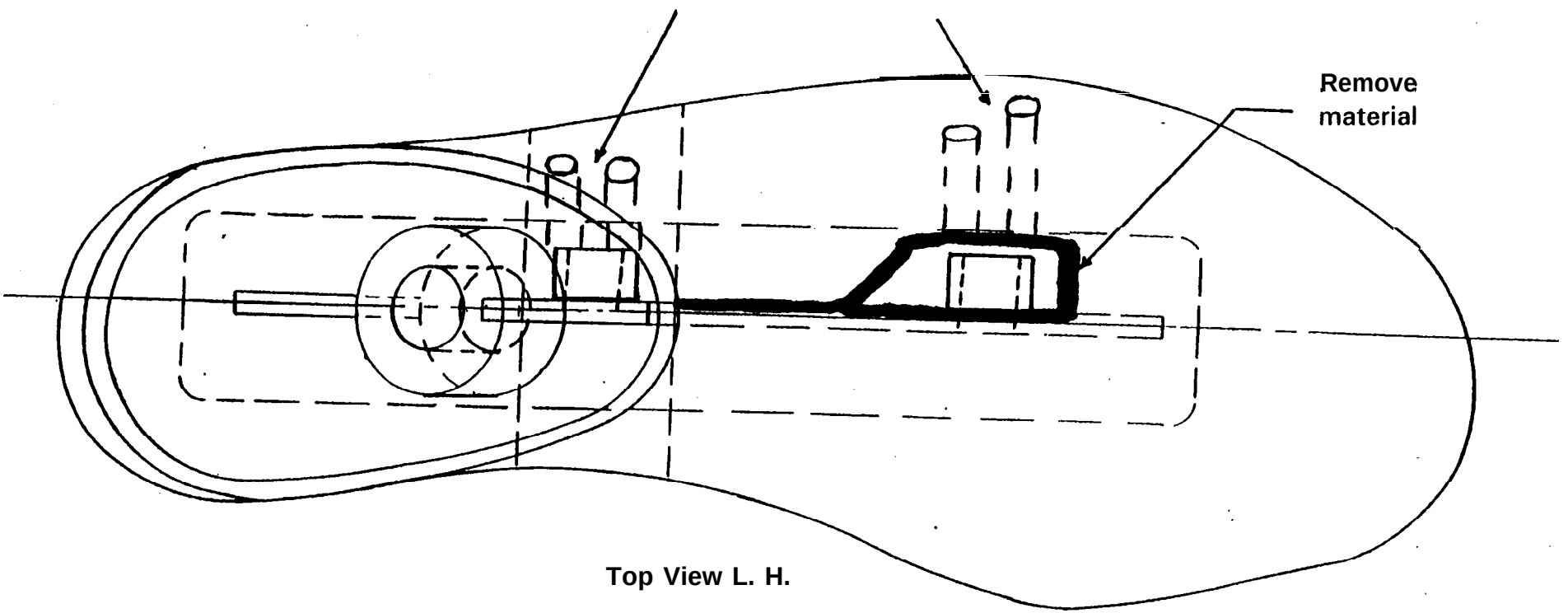
	QTY PER SUB NO.	PART OR IDENTIFYING NO.
	DIMENSIONS ARE IN INCHES TOLERANCES ARE: ± 1/16 .XX ± .XXX ±	APPROVALS
HYB III	MATERIAL SEE NOTE	DRAWN TREMAIN M.
	FINISH	CHECKED J. SMRCKA
NEXT ASS'Y USED ON		ISSUED
APPLICATION	DO NOT SCALE DRAWING	

Remove material as needed to mount cube and route cable.



78051-286
STRUCTURAL
ASS'Y

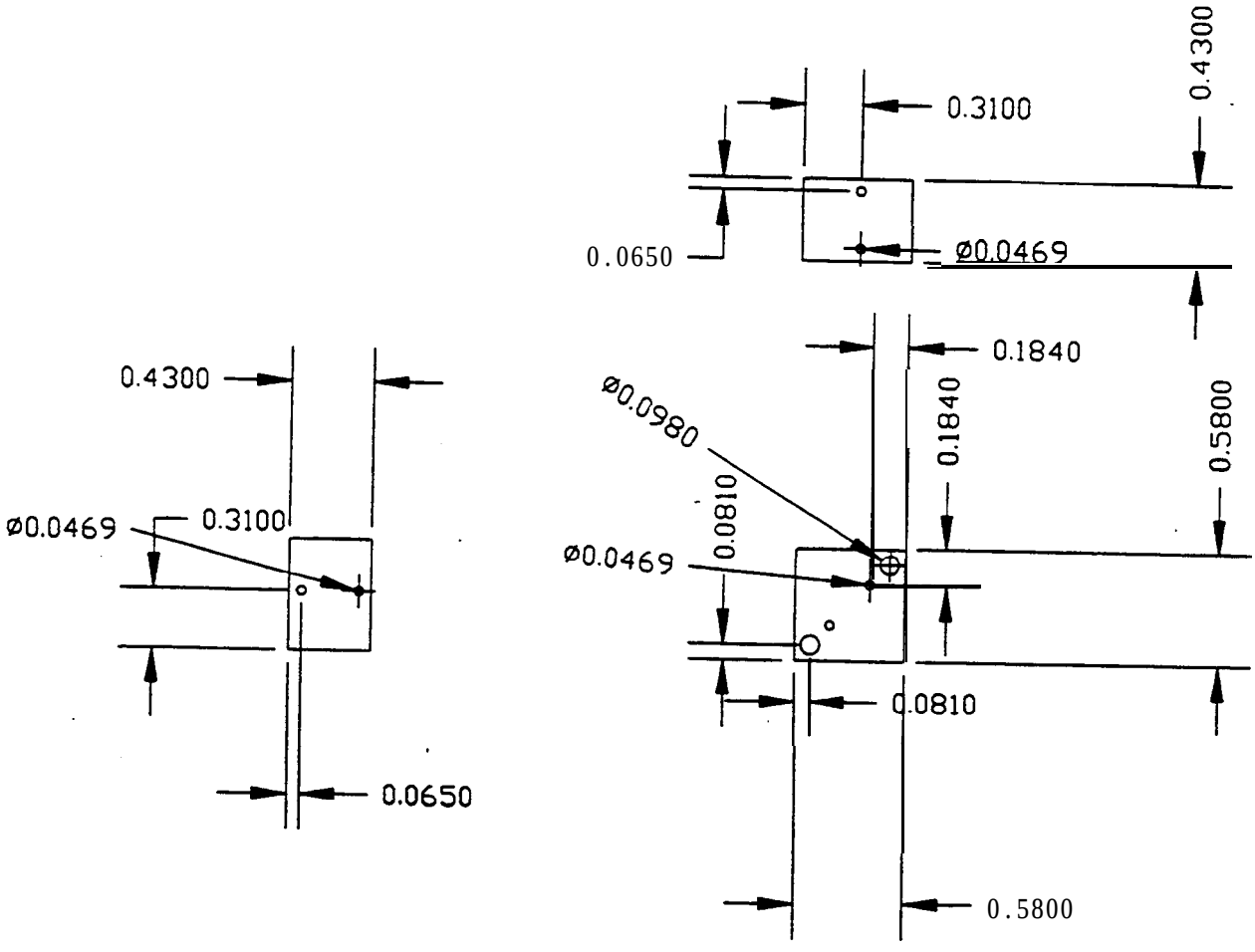
3/8 in. access holes.



Top View L. H.

Accelerometer cables are routed on top of the foot and from the ankle to the lower leg.

Foot cube.



ALL 0.0469 HOLES ARE TAPPED FOR O-80 SCREWS
ALL DIMENSIONS ARE IN INCHES

APPENDIX E

COMPUTER PROGRAMS

The online documentation and the first page of the source code are on the following pages.

A tape or diskette of these programs can be obtained from

National Highway Traffic Safety Administration
Office of Vehicle Research
Crashworthiness research Division
Mail Code: NRD-12
400 Seventh Street, SW
Washington, DC 20590
Telephone No.: 202-366-4850

```
      PROGRAM BWFILT

!-----------------------------------------------------------------------
!     Second-Order Butterworth Filter of UDS Y-Series Files
!
!     Programmer: E. Cheung
!                 Stuart G. Mentzer - Code framework
!
!     Fortran version - 1 1/94
!-----------------------------------------------------------------------

      INCLUDE 'uds_str.fh'

      RECORD / UDS_Y / U
      RECORD / UDS_CONTROL / C
      RECORD / FILE / HIT, REPORT, OUTPUT-LIST

      LOGICAL ALL-BATCH, NO-BATCH, NO-INCR, ONE-PASS, NEW-HIT, EOF,
     & BATCH, GROUP, NEW-GROUP, FN_VALID,
     & DEF-CUTOFF

      INTEGER NUM-ARGS, MAX_ARGS, IOS, IOS_W, I

      PARAMETER ( MAX-ARGS = 12 )

      REAL FCUT

      DOUBLEPRECISION CUTOFF, FCUT_DEF, FSTP_DEF

      CHARACTER CL_ARG(0:MAX_ARGS)* 132, PROG_NAME*8,
     & TEMPLATE_STR*132, DIR-OUT" 132,
     & FILE_NAME*132, OUT-FILE* 132, DEF_FILE*25,
     & PROMPT'79,
     & FCUT_C*25, FCUT_DEF_C*7, FSTP_DEF_C*7, FILCOD


      ! Initializations
      PROG_NAME = 'BWFilt'
      CALL GET_CL( CL-ARG, NUM-ARGS, MAX_ARGS )
      CALL. BWFILT_CL( CL-ARG, NUM-ARGS, PROG_NAME,
     & DEF_CUTOFF, CUTOFF )
      CALL PROC_CL( CL-ARG, NUM-ARGS, PROG NAME, TEMPLATE_STR,
     &  ALL-BATCH, NO-BATCH, NO-INCR, REPORT; OUTPUT-LIST, DIR_OUT,
     & ONE-PASS, .TRUE., .TR.UE. )
      PROMPT = 'UDS file name/template/hitlist?'
      PROMPT(74:) = '[done]'
      C.CHANFORM = 'Y' ! Only accept Y-series file input

      WRITE( , '(//25X,A//)' ) '** Butterworth Filtering . . '

      ! Read the file name/template/hitlist
```

```
100 CALL FILE_PROMPT( TEMPLATE-STR, PROMPT, DIR-OUT,
  &   ONE-PASS, HIT, NEW-HIT, FILE-NAME, EOF )
      IF ( ( FILE-NAME .EQ. ' ' ) .OR. ( EOF ) ) GO TO 199 ! Done

      ! Batch/group setup
      CALL BAT_SET( ALL-BATCH, NO-BATCH, NEW-HIT, HIT, BATCH )
      CALL GROUP_SET( HIT, NEW-HIT, BATCH, 2, GROUP, NEW-GROUP )

      ! Group prompts
      IF ( NEW-GROUP ) THEN

          ! Get cutoff frequency
101       IF ( DEF_CUTOFF ) THEN
                    FCUT-C = ' '
          ELSE IF ( CUTOFF .GT. O.DO ) THEN
                    FCUT  = CUTOFF
                    FCUT-C = 'NOT  BLANK'
          ELSE
                    WRITE( , '(/A,47X,A/" > > "$)' )
  &                 ' Cutoff  frequency  (Hz)  ?', '[default]'
                    READ( *, '(A)', IOSTAT = IOS ) FCUT-C
                    IF ( IOS .NE. 0 ) THEN
                          CALL MSG_WRITE( '* * * Operation skipped', REPORT )
                          CALL FILE_DEL( HIT )
                          GO TO 190
                    END IF
                    IF ( FCUT-C .NE. ' ' ) THEN
                          READ( FCUT-C, '(BN,F25.0)', IOSTAT = IOS ) FCUT
                          IF ( ( IOS .NE. 0 ) .OR. ( FCUT .LE. 0. ) ) THEN
                                WRITE( , * ) '* * Invalid frequency'
                                GO TO 101
                          END IF
                    END IF
          END IF

      END IF

      ! Read UDS file
      CALL REP_COLS( REPORT )
      CALL UDS_GET( FILE-NAME, U, C, REPORT, IOS )
      IF ( IOS .NE. 0 ) GO TO 190

      ! Check file fields
      IF ( ( U.CURTYP .NE. 'TIME SERIES' ) .OR.
  &   ( U.XTYP .NE. 'TIME' ) .OR.
  &   ( U.XUNITS .NE. 'SECONDS' ) )
  & CALL MSG_WRITE( '* * WARNING - Not a time series file',
  & REPORT )
      IF ( ( U.NFP .GT. 0 ) .OR. ( U.NLP .LE. 0 ) ) CALL MSG_WRITE(
  &   '* * * WARNING - Nonstandard x-axis span', REPORT )

      ! Determine default cutoff frequency value
```

```
      CALL FREQ_DEF( U, O.DO, O.DO, FCUT-DEF, FCUT_DEF_C,
     & FSTP_DEF, FSTP_DEF_C )

      IF ( .NOT. GROUP ) THEN ! Interactive prompts

          ! Get cutoff frequency value
  102     IF ( DEF_CUTOFF ) THEN
                  FCUT-C = ' '
                  FCUT  = FCUT_DEF
          ELSE IF ( CUTOFF .GT. 0.D0 ) THEN
                  FCUT = CUTOFF
                  FCUT-C = ' N O T   B L A N K '
          ELSE
                  ! Show file info
                  WRITE( *, '(/5X,2A/5X,A,F9.3,A/5X,A,F9.3,A)',
     &                   IOSTAT = IOS_W )
     &                   ' Sensor Attachment: ', U.SENATT,
     &                   ' Prefilter Frequency: ', U.PREF, ' (Hz)',
     &                   ' Cutoff Frequency:    ', U.FCUT, ' (Hz)'
                  WRITE( , '(/A,47X,A/'' > > ''$)' )
     &                   ' Cutoff frequency (Hz) ?', '['//FCUT_DEF_C//']'
                  READ( , '(A)', IOSTAT = IOS ) FCUT_C
                  IF ( IOS .NE. 0 ) THEN
                          CALL MSG_WRITE('* * Operation skipped', REPORT )
                          GO TO 190
                  END IF
                  IF ( FCUT-C .EQ. ' ' ) THEN
                          FCUT  = FCUT-DEF
                  ELSE
                          READ( FCUT-C, '(BN,F25.0)', IOSTAT = IOS ) FCUT
                          IF ( ( IOS .NE. 0 ) .OR. ( FCUT .LE. 0. ) ) THEN
                                  WRITE( *, * ) '* * Invalid frequency'
                                  GO TO 102
                          END IF
                  END IF
          END IF

      ELSE ! Group

          IF ( FCUT-C .EQ. ' ' ) FCUT = FCUT-DEF

      END IF

      ! Perform filtering
      IF ( FCUT .GT. 0. ) THEN
          CALL BWFILT_S( U.Y(U.NFP), U.NFP, U.NLP, U.DEL, FCUT )
      ELSE
          CALL MSG_WRITE('* * WARNING - No filtering performed',
     &         REPORT )
      END IF
```

```
      ! Prepare output fields
      U.STATUS = 'FILTERED'
      U.HIC = 0.
      U.T1 = 0.
      U.T2 = 0.
      U.HICDTUP = 0.
      U.CLIP3M = 0.
      U.CSI = 0.
      U.FCUT = FCUT
      U.FSTP = 2.5 * FCUT
      IF ( ( ( U.FCOR .GT. 0. ) .AND. ( U.FSTP .GT. U.FCOR ) ) .OR.
     &   ( ( U.PREF .GT. 0. ) .AND. ( U.FSTP .GT. .5*U.PREF ) ) ) THEN
            CALL MSG_WRITE('* * WARNING - Filter causes overlap '//
     &       'distortion with previous filtering', REPORT )
            U.STATUS = 'DISTORTED'
      END IF
      U.FCOR = .5 * FCUT
      U.CD1 = 'BWFILT Filtered'

      ! Set default output file name
      OUT-FILE = FILE-NAME
      CALL FN_EXTRACT( OUT-FILE )
      CALL FILTER_FLAG( U.CURTYP, U.FCUT, U.FSTP, FILCOD )
      CALL FN_FLAG( OUT-FILE, 'f'//FILCOD, 2, I )
      CALL ADD_PATH( DIR-OUT, OUT-FILE )
      IF ( .NOT. NO_INCR ) CALL FN_INCR( OUT-FILE )
      CALL FN_EXTRACT( OUT-FILE )
      DEF-FILE = OUT-FILE

      ! Set the output UDS file name
      IF ( .NOT. BATCH ) THEN
120       WRITE( , '(/A,31X,A/" > > "$)' )
     &       ' Output UDS file name?', '['//DEF_FILE//']'
          READ( , '(A)', END = 190 ) OUT_FILE
          IF ( OUT-FILE .EQ. ' ' ) THEN ! Use default file name
                OUT-FILE = DEF-FILE
          ELSE ! Check file name validity
                CALL ADD_PATH( DIR-OUT, OUT-FILE )
                IF ( .NOT. FN_VALID( OUT-FILE ) ) THEN
                      WRITE( , ) '* * Invalid file name'
                      GO TO 120
                END IF
          END IF
      ELSE ! Batch
          OUT-FILE = DEF FILE
      END IF

      ! Write the output UDS file
      CALL UDS_PUT( OUT-FILE, U, C, REPORT, OUTPUT-LIST,
     & DIR-OUT, .TRUE., IOS )

      ! Loop for next file
190 WRITE( , '(80("_"))')
```

```
      GO TO 100

      ! Clean up and stop
  199 CALL CLEAN_UP( HIT, REPORT, OUTPUT-LIST, DIR-OUT )

      END



      SUBROUTINE BWFILT_CL( CL-ARG, NUM-ARGS, PROG-NAME,
     & DEF-CUTOFF, CUTOFF )

!-----------------------------------------------------------------------
!
!     Processes the Program-Specific Command Line Arguments
!
!-----------------------------------------------------------------------

      LOGICAL DEF-CUTOFF

      INTEGER NUM-ARGS, I, NS, IOS, L-TRIM

      DOUBLEPRECISION CUTOFF

      CHARACTER CL_ARG(0:*)*(*), PROG_NAME*(*),
     & ARG"132, C


      ! Process command line arguments
      DEF-CUTOFF = .FALSE.
      CUTOFF = O.DO
      DO I = 1, NUM-ARGS
          CALL STR_UPCASE( ARG, CL_ARG(I) )
          C = ARG(1:1)
          IF ( ( C .EQ. '-' ) .OR. ( C .EQ. '/' ) ) THEN
                  NS = 2
          ELSE
                  NS = 1
          END IF
          IF ( ( ARG(NS:) .EQ. '?' ) .OR.
     &         ( ARG(NS:) .EQ. '??' ) .OR.
     &         ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line syntax
                  CALL SYNTAX_CL( PROG-NAME )
                  WRITE( • , '(10X,A)' ) '[CUTOFF = < cutoff-freq > I'
                  IF ( ( ARG(NS:) .EQ. '??' ) .OR.
     &                 ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line help
                          CALL HELP_CL( PROG-NAME )
                          WRITE( *, '(10X,A)' )
     &                         ' < cutoff-freq > : Cutoff frequency (blank = > default)'
```

```
                END IF
                STOP ''
        ELSE IF ( ( ARG(NS:NS + 6) .EQ. 'CUTOFF = ' ) .OR.
&       ( ARG(NS:NS+6) .EQ. 'CUTOFF#' ) ) THEN
                IF ( ARG(NS+7:) .EQ. ' ' ) THEN ! Default
                        DEF-CUTOFF = .TRUE.
                        CUTOFF = O.DO
                ELSE
                        READ( ARG(NS + 7:), '(BN,F25.0)', IOSTAT = IOS ) CUTOFF
                        IF ( ( IOS .NE. 0 ) .OR. ( CUTOFF .LE. O.DO ) ) THEN
                                WRITE( , '(/2A)' ) ' Illegal cutoff frequency: ',
                                 ARG(NS + 7:L_TRIM(ARG))
                                CUTOFF = O.DO
                        ELSE
                                DEF-CUTOFF = .FALSE.
                        END IF
                END IF
                CL_ARG(I) = ' '
        ELSE IF ( ARG(NS:) .EQ. 'CUTOFF' ) THEN ! Default
                DEF-CUTOFF = .TRUE.
                CUTOFF = O.DO
                CL_ARG(I) = ' '
        END IF
    END DO

    RETURN
    END
```

```
      PROGRAM RESULT

!-----------------------------------------------------------------------
!     Resultant of UDS Y-Series Files
!
!     Author: Stuart G. Mentter
!
!     Fortran version - 1 1/94
!-----------------------------------------------------------------------

      INCLUDE 'uds_str.fh'

      RECORD / UDS_Y / S, U
      RECORD / UDS_CONTROL / C
      RECORD / FILE / HIT, REPORT, OUTPUT-LIST

      LOGICAL ALL-BATCH, NO-BATCH, NO-INCR, ONE-PASS, NEW-HIT, EOF,
     &  BATCH, DONE, FN_VALID, ANY-CHARS, EQUAL-SP

      INTEGER NUM-ARGS, MAX-ARGS, IOS, I, IX, IY,
     & NUM_FILES, NPER-CL, NPER

      PARAMETER ( MAX-ARGS = 12 )

      CHARACTER CL_ARG(0:MAX_ARGS)*132, PROG_NAME*8,
     &  TEMPLATE-STR* 132, DIR-OUT* 132,
     &  FILE-NAME* 132, OUT-FILE* 132, DEF_FILE* 12,
     &  PROMPT-1 ● 79, PROMPT-2'79, PROMPT_3*79, PROMPT 0'79,
     &  XUNITS_1*20, YUNITS_1● 20, NPER_C, AXES*3, AXIS, CSYS


      ! Initializations
      PROG-NAME = 'Result'
      CALL GET_CL( CL-ARG, NUM-ARGS, MAX-ARGS )
      CALL RESULT_CL( CL-ARG, NUM-ARGS, PROG-NAME, NPER_CL )
      CALL PROC_CL( CL-ARG, NUM-ARGS, PROG-NAME, TEMPLATE-STR,
     &  ALL-BATCH, NO-BATCH, NO-INCR, REPORT, OUTPUT-UST, DIR-OUT,
     & ONE-PASS, .TRUE., .TRUE. )
      PROMPT-1 = 'First UDS file name/template/hitlist?'
      PROMPT-1 (74:) = '[done]'
      PROMPT-2 = 'Second UDS file name/template/hitlist?'
      PROMPT_2(71 :) = '[no morel'
      PROMPT-3 = 'Third UDS file name/template/hitlist?'
      PROMPT_3(71:) = '[no morel'
      C.CHANFORM = 'Y' ! Only accept Y-series file input

      WRITE( *, '(//25X,A//)' ) '** Resultant of UDS Files **'

      ! Read the first file name/template/hitlist
100   CALL FILE_PROMPT( TEMPLATE-STR, PROMPT-l, DIR-OUT,
     &  ONE-PASS, HIT, NEW-HIT, FILE-NAME, EOF )
```

```
      IF ( ( FILE-NAME .EQ. ' ' ) .OR. ( EOF ) ) GO TO 199 ! Done

      ! Batch setup
      CALL BAT_SET( ALL-BATCH, NO-BATCH, NEW-HIT, HIT, BATCH )

      ! Set number of files per resultant
      IF ( NPER-CL .NE. 0 ) THEN ! Use command line value
          NPER = NPER-CL
      ELSE IF ( ( NEW-HIT ) .AND. ( HIT.OPEN ) ) THEN ! Prompt for value
          IF ( HIT.N_REC .LE. 0 ) THEN
                  NPER = 1
          ELSE
  101             IF ( ( ONE-PASS ) .AND. ( HIT.N_REC .EQ. 1 ) ) THEN
                      WRITE( , '(/A,38X,A/'' > > ''$)' )
     &                    ' Number of files per resultant?  (1/2)', '[2]'
                  ELSE
                      WRITE( , '(/A,36X,A/'' > > ''$)' )
     &                    ' Number of files per resultant?  (1/2/3)', '[3]'
                  END IF
                  READ( , '(A)', IOSTAT = IOS ) NPER-C
                  IF ( IOS .NE. 0 ) THEN
                      CALL MSG_WRITE( '. . . Operation skipped', REPORT )
                      CALL FILE_DEL( HIT )
                      GO TO 190
                  END IF
                  IF ( NPER-C .EQ. '' ) THEN
                      NPER = 3
                      IF ( ONE-PASS ) NPER = MIN( 3, HIT.N_REC + 1 )
                  ELSE
                      READ( NPER-C, '(BN,I1)', IOSTAT = IOS ) NPER
                      IF ( ( IOS .NE. 0 ) .OR. ( NPER .LE. 0 ) .OR.
                       ( NPER .GT. 3 ) .OR.
                      ( ( ONE-PASS ) .AND. ( NPER .GT. HIT.N_REC + 1 ) ) )
                       THEN
                          WRITE( , '(.)' ) '*** Unacceptable value'
                          GO TO 101
                      END IF
                  END IF
          END IF
      ELSE IF ( .NOT. HIT.OPEN ) THEN ! Allow up to 3 for interactive
          IF ( ONE-PASS ) THEN ! Only 1 file entered
                  NPER = 1
          ELSE
                  NPER = 3
          END IF
      END IF
```

```
      ! Read first UDS file
      CALL REP_COLS( REPORT )
      C.DIMSYS = ' '
      CALL UDS_GET( FILE-NAME, S, C, REPORT, IOS )
      IF ( IOS .NE. 0 ) THEN ! UDS read error
          IF ( HIT.OPEN ) THEN
                  DO I = 1, NPER-1
                      CALL FILE_SKIP( HIT )
                  END DO
          END IF
          GO TO 190
      END IF

      ! Process first UDS file
      XUNITS_1 = S.XUNITS
     YUNITS_1  = S.YUNITS
      C.DIMSYS = S.DIMSYS
      NUM-FILES = 1
      AXIS = S.AXIS(1:1)
      IF (. .NOT. ANY_CHARS( AXIS, 'XYZ' ) ) CALL MSG_WRITE(
     &  '. . . WARNING - Unrecognized axis: '//AXIS, REPORT )
      AXES = AXIS
      CSYS =      S.AXIS(2:2)

      ! Square first curve
      DO I = S.NFP, S.NLP
          S.Y(I) = S.Y(I)**2
      END DO

      ! Read/process the other UDS files
      DONE = .FALSE.
      PROMPT-O = PROMPT-2
      DO WHILE ( ( .NOT. DONE ) .AND. ( NUM-FILES .LT. NPER ) )

          ! Read another file name/template/hitlist
  110     CALL FILE_PROMPT( TEMPLATE-STR, PROMPT-O, DIR-OUT,
     &     ONE-PASS, HIT, NEW-HIT, FILE-NAME, EOF )

          IF ( EOF ) THEN
                  GO TO 190
          ELSE IF ( FILE-NAME .EQ. ' ' ) THEN ! No more files
                  IF ( ONE-PASS ) THEN
                      CALL MSG_WRITE(
     &                    '*** Operation skipped - Not enough files', REPORT )
                      GO TO 190
                  ELSE ! Accept <NPER files at user request
                      DONE = .TRUE.
                  END IF
          ELSE ! Read/process a file

                  ! Read next UDS file
                  CALL UDS_GET( FILE-NAME, U, C, REPORT, IOS )
                  IF ( IOS .NE. 0 ) THEN ! UDS read error
```

```
                IF ( ( HIT.OPEN ) .OR. ( ONE-PASS ) ) THEN ! Skip to next
                        DO I = 1, NPER-NUM_FILES-1
                                CALL FILE_SKIP( HIT )
                        END DO
                        GO TO 190
                ELSE
                        GOT0  110
                END IF
        END IF

        ! Check UDS fields for consistency
        IF ( .NOT. EQUAL-SP( U.DEL, S.DEL, 2.E-7 ) ) THEN
                CALL MSG_WRITE('* . * ERROR - Inconsistent DEL step',
                 REPORT )
                IF ( ( HIT.OPEN ) .OR. ( ONE-PASS ) ) THEN ! Skip to next
                        DO I = 1, NPER-NUM_FILES-1
                                CALL FILE_SKIP( HIT )
                        END DO
                        GO TO 190
                ELSE
                        GO TO 110
                END IF
        END IF
        IF ( U.YUNITS .NE. YUNITS_1 ) CALL MSG WRITE(
&        '*** WARNING - Inconsistent Y-units', REPORT )
        IF ( U.XUNITS .NE. XUNITS_1 ) CALL MSG_WRITE(
&        '*** WARNING - Inconsistent X-units', REPORT )
        AXIS = U.AXIS(1:1)
        IF ( .NOT. ANY_CHARS( AXIS, 'XYZ' ) ) CALL MSG WRITE(
&        '* . . WARNING - Unrecognized axis: '//U.AXIS, REPORT )
        IF ( U.AXIS(2:2) .NE. CSYS ) CALL MSG_WRITE(
&        '*** WARNING - Inconsistent axis coordinate system',
&         REPORT )
        IF ( INDEX( AXES, AXIS ) .NE. 0 ) CALL MSG WRITE(
&        '* . . WARNING - Repeat axis: '//AXIS, REPORT )

        ! Merge UDS fields
        CALL UDS_MERGE( U, S )

        ! Add curve to squared sum
        DO I = S.NFP, S.NLP
                S.Y(I) = S.Y(I) + U.Y(I)**2
        END DO

        ! Update for this file
        NUM-FILES = NUM_FILES + 1
```

```
                AXES(NUM_FILES:NUM_FILES) = U.AXIS(1:1)

                ! Set up for next file
                IF ( NUM_FILES .EQ. 2 ) THEN
                        PROMPT-O = PROMPT-3
                ELSE
                        DONE = .TRUE.
                END IF
        END IF

    END DO

    ! Take square root to get resultant
    DO I = S.NFP, S.NLP
        S.Y(I) = SQRT( S.Y(I) )
    END DO

    ! Prepare output fields
    S.CURNAM = 'RES'
    S.STATUS = 'COMPUTED'
    S.HIC = 0.
    S.T1 = 0.
    S.T2 = 0.
    S.HICDTUP = 0.
    S.CLIP3M = 0.
    S.CSI = 0.
    IF ( S.AXIS .EQ. ' ' ) S.AXIS = 'RS'
    IX = INDEX( AXES, 'X' )
    IF ( IX .GT. 1 ) THEN
        AXES(IX:IX) = AXES(1:1)
      AXES(1:1) =  ' X '
    END IF
    IY = INDEX( AXES, 'Y' )
    IF ( IY .GT. 2 ) THEN
        AXES(IY:IY) = AXES(2:2)
        AXES(2:2) = 'Y'
    END IF
    S.CD2 = 'Resultant of 'IIAXESII' axis curves'

    ! Set default output file name
    CALL FN_DEF( S, OUT-FILE )
    CALL FN_COMBO( S, OUT-FILE )
    CALL ADD_PATH( DIR-OUT, OUT-FILE )
    IF ( .NOT. NO_INCR ) CALL FN_INCR( OUT-FILE )
    CALL FN_EXTRACT( OUT-FILE )
    DE+FILE = OUT-FILE

    ! Set the output UDS file name
    IF ( .NOT. BATCH ) THEN
120     WRITE( , '(/A,44X,A/'' > > ''$)' )
  &      ' Output UDS file name?', '['//DEF_FILE//']'
        READ( , '(A)', END = 190 ) OUT-FILE
        IF ( OUT-FILE .EQ. ' ' ) THEN ! Use default file name
                OUT-FILE = DEF_FILE
```

```
            ELSE ! Check file name validity
                    CALL ADD_PATH( DIR-OUT, OUT-FILE )
                    IF ( .NOT. FN_VALID( OUT-FILE ) ) THEN
                        WRITE( *, '*' * Invalid file name'
                        GO TO 120
                    END IF
            END IF
        ELSE ! Batch
            OUT-FILE = DEF_FILE
        END IF

        ! Write the output UDS file
        CALL UDS_PUT( OUT-FILE, S, C, REPORT, OUTPUT-LIST,
     & DIR-OUT, .TRUE., IOS )

        ! Loop for next operation
  190 WRITE( *, '(80(''_''))' )
        GO TO 100

        ! Clean up and stop
  199 CALL CLEAN_UP( HIT, REPORT, OUTPUT-LIST, DIR-OUT )

        END



        SUBROUTINE RESULT_CL( CL_ARG, NUM-ARGS, PROG_NAME, NPER-CL )

!-------------------------------------------------------------------
!
!       Processes the Program-Specific Command Line Arguments
!
!-------------------------------------------------------------------

        INTEGER NUM-ARGS, IOS, I, NS, NPER-CL, L-TRIM

        CHARACTER CL_ARG(0:*)*(*), PROG_NAME*(*),
     & ARG*132, C


        ! Process command line arguments
        NPER-CL = 0
        DO I = 1, NUM-ARGS
            CALL STR_UPCASE( ARG, CL_ARG(I) )
            C = ARG(1:1)
            IF ( ( C .EQ. '-' ) .OR. ( C .EQ. '/' ) ) THEN
                    NS = 2
            ELSE
                    NS = 1
            END IF
            IF ( ( ARG(NS:) .EQ. '?' ) .OR.
     &         ( ARG(NS:) .EQ. '??' ) .OR.
```

```
&       ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line syntax
                CALL SYNTAX_CL( PROG-NAME )
                WRITE( , '(10X,A)' ) '[NPER = < num-per > I'
                IF ( ( ARG(NS:) .EQ. '??' ) .OR.
&                ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line help.
                        CALL HELP_CL( PROG-NAME )
                        WRITE( , '(10X,A)' )
&                        '< num-per > :  Number of files per resultant (I-3) [3]'
                END IF
                STOP ''
        ELSE IF ( ( ARG(NS:NS + 4) .EQ. 'NPER = ' ) .OR.
&       ( ARG(NS:NS + 4) .EQ. 'NPER#' ) ) THEN
                READ( ARG(NS + 5:), '(BN,I25)', IOSTAT = IOS ) NPER-CL
                IF ( ( IOS .NE. 0 ) .OR. ( NPER-CL .LE. 0 ) .OR.
&                ( NPER-CL .GT. 3 ) ) THEN
                        WRITE( *, '(/2A)' )
&                        '* * * Illegal number of files per resultant: ',
&                        ARG(NS + 5:L_TRIM(ARG))
                        NPER-CL = 0
                END IF
                CL_ARG(I) = ' '
        ELSE IF ( ( ARG(NS:NS + 2) .EQ. 'NF = ' ) .OR.
&       ( ARG(NS:NS + 2) .EQ. 'NF#' ) ) THEN ! Support old switch
                READ( ARG(NS + 3:), '(BN,I5)', IOSTAT = IOS ) NPER-CL
                IF ( ( IOS .NE. 0 ) .OR. ( NPER-CL .LE. 0 ) .OR.
&                ( NPER-CL .GT. 3 ) ) THEN
                        WRITE( , '(/2A)' )
&                        '* ** Illegal number of files per resultant: ',
&                        ARG(NS + 3:L_TRIM(ARG))
                        NPER-CL = 0
                END IF
                CL_ARG(I) = ' '
        END IF
    END DO

    RETURN
    END
```

```
      PROGRAM  CLIP

!-----------------------------------------------------------------------
!
!     CLIP Version 2.1
!
!     Computes the maximum value that the linear interpolation of a UDS time
!     series, typically a chest resultant acceleration filtered to 300 Hz
!     cutoff, meets or exceeds for an interval of at least 3 msec, based on
!     the linearly interpolated time series.
!
!     The Chest Severity Index (CSI) is also computed.
!
!     An updated version of the UDS file with the computed CLIP and CSI
!     values can be optionally output.
!
!     Author: Stuart G. Mentzer
!
!     Fortran version - 11/94
!-----------------------------------------------------------------------

      INCLUDE 'uds_str.fh'

      RECORD / UDS_Y / U
      RECORD / UDS_CONTROL / C
      RECORD / FILE / HIT, REPORT, OUTPUT-LIST

      LOGICAL ALL-BATCH, NO-BATCH, NO-INCR, ONE-PASS, NEW-HIT, EOF,
     & BATCH, FN_VALID,
     & UPDATE

      INTEGER NUM-ARGS, MAX-ARGS, IOS, NFP_C, I

      PARAMETER ( MAX-ARGS = 12 )

      REAL DELC, TL, TR

      PARAMETER ( DELC = .003 )

      CHARACTER CL_ARG(0:MAX_ARGS)*132, PROG_NAME*8,
     &  TEMPLATE STR*132, DIR_OUT* 132,
     &  FILE-NAME, 132, OUT_FILE* 132, DEF_FILE*25,
     & PROMPT*79


      ! Initializations
      PROG_NAME = 'Clip'
      CALL GET_CL( CL-ARG, NUM_ARGS, MAX-ARGS )
```

```
      CALL CLIP_CL( CL-ARG, NUM-ARGS, PROG_NAME, UPDATE )
      CALL PROC_CL( CL-ARG, NUM-ARGS, PROG NAME, TEMPLATE STR,
   81  ALL-BATCH, NO-BATCH, NO-INCR, REPORT: OUTPUT-LIST, DIR-OUT,
     & ONE-PASS, .TRUE., .TRUE. )
      PROMPT = 'UDS file name/template/hitlist?'
      PROMPT(74:) = '[done]'
      C.CHANFORM = 'Y' ! Only accept Y-series file input

      WRITE(*, '(//25X,A//)') '** Clip Program (v.2.1) . . '

      ! Read the file name/template/hitlist
  100 CALL FILE_PROMPT( TEMPLATE-STR, PROMPT, DIR-OUT,
     &  ONE-PASS, HIT, NEW-HIT, FILE-NAME, EOF )
      IF ( ( FILE-NAME .EQ. ' ' ) .OR. ( EOF) ) GO TO 199 ! Done

      ! Batch setup
      CALL BAT_SET( ALL-BATCH, NO-BATCH, NEW-HIT, HIT, BATCH )

      ! Read UDS file
      CALL REP_COLS( REPORT )
      CALL UDS_GET( FILE-NAME, U, C, REPORT, IOS )
      IF ( IOS .NE. 0 ) GO TO 190

      ! Check file fields
      IF ( ( U.CURTYP .NE. 'TIME SERIES' ) .OR.
     &  ( U.XTYP .NE. 'TIME' ) .OR.
     &  ( U.XUNITS .NE. 'SECONDS' ) .OR.
     &  ( ( U.CURNAM(:4) .NE. 'RES ') .AND. ( U.AXIS .NE. 'RS' ) ) )
     & CALL MSG_WRITE(
     &  '* . * WARNING - Not a resultant time series file', REPORT )
      IF ( ( U.SENATT .NE. 'CHEST' ) .OR. ( U.YUNITS .NE. 'G''S' )
     &  .OR. ( U.FCUT .NE. 300. ) ) CALL MSG_WRITE(
     &  '*** WARNING - Not 300 Hz CHEST acceleration in G'S', REPORT )
      IF ( ( U.NFP .GT. 0 ) .OR. ( U.NLP .LE. 0 ) ) CALL MSG_WRITE(
     &  '*** WARNING - Nonstandard x-axis span', REPORT )
      IF ( U.DEL .LE. 0. ) THEN
          CALL MSG_WRITE(
     &      '* . . ERROR - Non-positive file time step value', REPORT )
          GO TO 190
      END IF

      ! Set lower index for CLIP/CSI computation
      NFP-C = MAX( 0, U.NFP )

      ! Compute the CLIP value
      IF ( ( U.NLP - NFP-C ) . U.DEL .LT. DELC ) THEN ! Not > = 3 msec of data
          CALL MSG_WRITE(
     &      '* . . WARNING - Less than 3 msec of post-time-zero
```

```
data - '//
    &       'CLIP3M set to zero', REPORT )
            U.CLIP3M = 0.
            TL = 0.
            TR = 0.
        ELSE
            CALL CLIP_S( U.Y(NFP_C), NFP-C, U.NLP, U.DEL,
    &       U.CLIP3M, TL, TR, IOS )
        END IF

        ! Compute the Chest Severity Index (CSI) value
        U.CSI = ( ABS( U.Y(NFP_C) )**2.5 + ABS( U.Y(U.NLP) )**2.5 ) / 2
        DO I = NFP-C + 1, U.NLP-1
            U.CSI = U.CSI + ABS( U.Y(I) )**2.5
        END DO
        U.CSI = U.CSI . U.DEL

        ! Report results
        IF ( ( TL .LE. NFP-C . U.DEL * 1000 + 30. ) .OR.
    &    ( TR .GE. U.NLP . U.DEL . 1000 - 30. ) )
    &  CALL MSG_WRITE( '*** WARNING - CLIP span overlaps '//
    &    'first or last 30 msec of signal', REPORT )
        WRITE( , '(/5X,A,F10.3,5X,A,F9.3,A,5X,A,F9.3,A/5X,A,F13.3)',
    &  IOSTAT=IOS )
    &    'CLIP3M = ', U.CLIP3M, 'TL = ', TL, ' (msec)',
    &  'TR = ', TR, ' (msec)', 'CSI = ', U.CSI
        IF ( REPORT.OPEN ) WRITE( REPORT.UNIT,
    &    '(5X,A,F10.3,5X,A,F9.3,A,5X,A,F9.3,A,5X,A,F13.3)',
    &  IOSTAT=IOS )
    &    'CLIP3M = ', U.CLIP3M, 'TL = ', TL, ' (msec)',
    &    'TR = ', TR, ' (msec)', 'CSI = ', U.CSI

        ! Set default output file name
        OUT-FILE = FILE-NAME
        CALL FN_EXTRACT( OUT-FILE )
        CALL ADD_PATH( DIR-OUT, OUT-FILE )
        CALL FN_EXTRACT( OUT-FILE )
        DEF_FILE = OUT-FILE

        ! Set the output UDS file name
        IF ( .NOT. BATCH ) THEN
120         WRITE( , '(IA, 16X,A/'' > > ''$)' )
    &       ' Output UDS file name?  ( N - None )', '['//DEF_FILE//']'
            READ( ,  ', '(A)', END = 190 ) OUT-FILE
            IF ( OUT-FILE .EQ. ' ' ) THEN ! Use default file name
                    OUT-FILE = DE+FILE
            ELSE IF ( ( OUT-FILE .EQ. 'N' ) .OR.
    &       ( OUT-FILE .EQ. 'n' ) ) THEN ! No output file
                    OUT_FILE(1:1) = 'N'
            ELSE ! Check file name validity
                    CALL ADD_PATH( DIR-OUT, OUT-FILE )
                    IF ( .NOT. FN_VALID( OUT-FILE ) ) THEN
```

```
                        WRITE( ●  , • )'** • Invalid file name'
                        GO TO 120
                    END IF
                END IF
            ELSE ! Batch
                IF ( UPDATE ) THEN
                    OUT-FILE = DEF_FILE
                ELSE
                    OUT-FILE = 'N'
                END IF
            END IF

            ! Write the output UDS file
            IF ( OUT-FILE .NE. 'N' ) THEN
                CALL UDS_PUT( OUT-FILE, U, C, REPORT, OUTPUT-LIST,
     &           DIR-OUT, .FALSE., IOS )
                IF ( IOS .NE. 0 ) GO TO 190
            END IF

            ! Loop for next file
  190 WRITE( ●  , '(80(''_''))')
            GO TO 100

            ! Clean up and stop
  199 CALL CLEAN_UP( HIT, REPORT, OUTPUT-LIST, DIR-OUT )

            END



            SUBROUTINE CLIP_CL( CL-ARG, NUM-ARGS, PROG_NAME, UPDATE )

!-------------------------------  ------------------------------
!
!       Processes the Program-Specific Command Line Arguments
!
!-------------------------------------------------------------------

            LOGICAL UPDATE

            INTEGER NUM-ARGS, I, NS

            CHARACTER CL_ARG(0:*)*(*), PROG_NAME*(*),
     &  ARG'132, C


            ! Process command line arguments
            UPDATE = .FALSE.
            DO I = 1, NUM-ARGS
                CALL STR_UPCASE( ARG, CL_ARG(I) )
                C = ARG(1:1)
                IF ( ( C .EQ. '-' ) .OR. ( C .EQ. '/' ) ) THEN,
```

```
                NS = 2
        ELSE
                NS = 1
        END IF
        IF ( ( ARG(NS:) .EQ. '?' ) .OR.
&        ( ARG(NS:) .EQ. '??' ) .OR.
&        ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line syntax
                CALL SYNTAX_CL( PROG-NAME )
                WRITE( *, '(1 0X,A)' ) '[UPDATE]'
                IF ( ( ARG(NS:) .EQ. '??' ) .OR.
&                ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line help
                        CALL HELP_CL( PROG-NAME )
                        WRITE( , '(10X,A)' )
&                        'UPDATE : Output CLIP/CSI-updated UDS files'
                END IF
                STOP ''
        ELSE IF ( ARG(NS:) .EQ. 'UPDATE' ) THEN
                UPDATE = .TRUE.
                CL_ARG(I) = ' '
        END IF
    END DO

    RETURN
    END
```

```
      PROGRAM HIC36

!-----------------------------------------------------------------------
!     Computes the maximum 36 msec Head Injury Criterion value
!     and the corresponding time interval using an efficient global
!     branch and bound algorithm.
!
!     Author: Stuart G. Mentzer
!
!     Fortran version - 10/94
!-----------------------------------------------------------------------

      INCLUDE 'uds_str.fh'

      RECORD / UDS_Y / U, S
      RECORD / UDS_CONTROL / C
      RECORD / FILE / HIT, REPORT, OUTPUT-LIST

      LOGICAL ALL-BATCH, NO-BATCH, NO-INCR, ONE-PASS, NEW-HIT, EOF,
     &  BATCH, FN_VALID,
     &  UPDATE

      INTEGER NUM-ARGS,. MAX-ARGS, IOS, NAR

      PARAMETER ( MAX-ARGS = 12 )

      PARAMETER ( NAR = NLP_U • 2 ) ! Larger NAR helps avoid slow method

      INTEGER JL(NAR), KL(NAR)

      CHARACTER CL_ARG(0:MAX_ARGS)*132, PROG_NAME*8,
     &  TEMPLATE_STR*132, DIR_OUT* 132,
     &  FILE_NAME* 132, OUT_FILE* 132, DEF_FILE*25,
     &  PROMPT*79


      ! initializations
      PROG-NAME = 'HIC36'
      CALL GET_CL( CL-ARG, NUM-ARGS, MAX-ARGS )
      CALL HIC36_CL( CL-ARG, NUM-ARGS, PROG-NAME, UPDATE )
      CALL PROC_CL( CL-ARG, NUM-ARGS, PROG-NAME, TEMPLATE-STR,
     &  ALL-BATCH, NO-BATCH, NO-INCR, REPORT, OUTPUT-LIST, DIR-OUT,
     &  ONE-PASS, .TRUE., .TRUE. )
      PROMPT = 'UDS file name/template/hitlist?'
      PROMPT(74:) = '[done]'
      C.CHANFORM = 'Y' ! Only accept Y-series file input

      WRITE( , '(//14X,A//)' )
     &  '** 36 Msec Head Injury Criterion Computation • *'
```

```
      ! Read the file name/template/hitlist
100   CALL FILE_PROMPT( TEMPLATE-STR, PROMPT, DIR-OUT,
     & ONE-PASS, HIT, NEW-HIT, FILE-NAME, EOF )
      IF ( ( FILE-NAME .EQ. '' ) .OR. ( EOF ) ) GO TO 199 ! Done

      ! Batch setup
      CALL BAT-SET( ALL-BATCH, NO-BATCH, NEW-HIT, HIT, BATCH )

      ! Read UDS file
      CALL REP-COLS( REPORT )
      CALL UDS_GET( FILE-NAME, U, C, REPORT, IOS )
      IF ( IOS .NE. 0 ) GO TO 190

      ! Check file fields
      IF ( ( U.CURTYP .NE. 'TIME SERIES' ) .OR.
     &   ( U.XTYP .NE. 'TIME' ) .OR.
     &   ( U.XUNITS .NE. 'SECONDS' ) .OR.
     &   ( ( U.CURNAM(:4) .NE. 'RES ') .AND. ( U.AXIS .NE. 'RS' ) ) )
     &   CALL MSG_WRITE(
     &   '* * WARNING - Not a resultant time series file', REPORT )
      IF ( ( U.SENATT .NE. 'HEAD CG' ) .OR.
     &   ( U.YUNITS .NE. 'G''S' ) .OR.
     &   ( U.FCUT .NE. 0. ) ) CALL MSG_WRITE(
     &   '* * * WARNING - Not raw HEAD CG acceleration data', REPORT )
      IF ( ( U.NFP .GT. 0) .OR. ( U.NLP .LE. 0 ) ) CALL
     &   MSG_WRITE('* * WARNING - Nonstandard x-axis span', REPORT )
      IF ( U.DEL .LE. 0. ) THEN
           CALL MSG_WRITE(
     &          '* * ERROR - Non-positive file time step value', REPORT )
           GO TO 190
      END IF

      ! Compute the HIC36 value
      U.HICDTUP = 36. ! Set max HIC time window to 36 msec
      CALL HIC_S( U.Y(0), S.Y(0), U.NFP, U.NLP, JL, KL, NAR,
     & U.HICDTUP, U-DEL, U.HIC, U.T1, U.T2, IOS )

      ! Report results
      WRITE( , '(/5X,A,F10.3,5X,A,F9.3,A,5X,A,F9.3,A)', IOSTAT=IOS )
     & 'HIC = ', U.HIC,
     & 'T1 = ', U.T1, ' (msec)',
     & 'T2 = ', U.T2, ' (msec)'
      IF ( REPORT.OPEN )
     & WRITE( REPORT.UNIT, '(5X,A,F10.3,5X,A,F9.3,A,5X,A,F9.3,A)',
     & IOSTAT=IOS )
     & 'HIC = ', U.HIC,
     & 'T1 = ', U.T1, ' (msec)',
```

```
     & 'T2  =  ', U.T2, ' (msec)'

       ! Set default output file name
       OUT-FILE = FILE_NAME
       CALL FN_EXTRACT( OUT-FILE )
       CALL ADD_PATH( DIR-OUT, OUT-FILE )
       CALL FN_EXTRACT( OUT-FILE )
       DEF-FILE  = OUT-FILE

       ! Set the output UDS file name
       IF ( .NOT. BATCH ) THEN
120        WRITE( ● , '(/A,1 6X,A/'' > > ''$)' )
     &         ' Output UDS file name?   ( N - None )', '['//DEF_FILE//']'
           READ( *, '(A)', END = 190 ) OUT-FILE
           IF ( OUT-FILE .EQ. ' ' ) THEN ! Use default file name
                     OUT-FILE  = DEF-FILE
           ELSE IF ( ( OUT-FILE .EQ. 'N' ) .OR.
     al         ( OUT-FILE .EQ. 'n' ) ) THEN ! No output file
                          OUT_FILE(1 :1) = 'N'
           ELSE ! Check file name validity
                     CALL ADD_PATH( DIR-OUT, OUT-FILE )
                     IF ( .NOT. FN_VALID( OUT-FILE ) ) THEN
                          WRITE( ●  , • )'*• * Invalid file name'
                          GO TO 120
                     END IF
           END IF
       ELSE ! Batch
           IF ( UPDATE ) THEN
                     OUT-FILE  =  DE+FILE
           ELSE
                     OUT-FILE  =  'N'
           END IF
       END IF

       ! Write the output UDS file
       IF ( OUT_FILE .NE. 'N' ) THEN
           CALL UDS_PUT( OUT-FILE, U, C, REPORT, OUTPUT-LIST,
     &          DIR-OUT, .FALSE., IOS )
       END IF

       ! Loop for next file
190 WRITE( ●  , '(80(''_''))' )
       GO TO 100

       ! Clean up and stop
199 CALL CLEAN_UP( HIT, REPORT, OUTPUT-LIST, DIR-OUT )

       END



       SUBROUTINE HIC36_CL( CL-ARG, NUM_ARGS, PROG_NAME, UPDATE )
```

```
!-----------------------------------------------------------------
!
!       Processes the Program-Specific Command Line Arguments
!
!-----------------------------------------------------------------------------

        LOGICAL  UPDATE

        INTEGER  NUM-ARGS, I, NS

        CHARACTER CL_ARG(0:*)*(*), PROG_NAME*(*),
     &  ARG*132,  C


        ! Process command line arguments
        UPDATE = .FALSE.
        DO I  = 1,  NUM-ARGS
            CALL STR_UPCASE( ARG, CL_ARG(I) )
            C = ARG(1:1)
            IF ( ( C .EQ. '-' ) .OR. ( C .EQ. '/' ) ) THEN
                        NS = 2
            ELSE
                        NS = 1
            END IF
            IF ( ( ARG(NS:) .EQ. '?' ) .OR.
     &           ( ARG(NS:) .EQ. '??' ) .OR.
     &           ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line syntax
                        CALL SYNTAX_CL( PROG-NAME )
                        WRITE( , '(10X,A)' ) '(UPDATE]'
                        IF ( ( ARG(NS:) .EQ. '??' ) .OR.
     &                       ( ARG(NS:) .EQ. 'HELP' ) ) THEN ! Show command line help
                                    CALL HELP_CL( PROG-NAME )
                                    WRITE( , '(10X,A)' )
     &                               'UPDATE : Output HIC-updated UDS files'
                        END IF
                        STOP ''
            ELSE IF ( ARG(NS:) .EQ. 'UPDATE' ) THEN
                        UPDATE = .TRUE.
                        CL_ARG(I) = ' '
            END IF
        END DO

        RETURN
        END
```

APPENDIX F

EVALUATION OF DATA ACQUISITION SYSTEM USING A SIGNAL WAVE GENERATOR

1. REFERENCES

A. MGA Research Corporation, Operator's Manual for Waveform Generator Model **RPG-6236-A,** (U. S. Department of Transportation, National Highway Traffic Safety Administration, February 1988)

B. **NHTSA Data Tape Reference Guide - Volume I, Vehicle Crash Tests,** (U.S. Department of Transportation, National Highway Traffic Safety Administration, August 1985)

C. Attachment 1 **- Data Tape Header Codes For Tests Using The SWG.**

D. **SAE J211 October 1988 - Instrumentation for Impact Test, SAE** recommended Practice, Revised October 1988.

2. DEFINITIONS

ATD	Anthropomorphic Test Device
Channel	Entire data path from sensor output interface, through the signal conditioner, the umbilical cable, and the DAS, to the digital data recorded on magnetic tape
Contractor	Owner(s) and operating personnel of the vehicle crash test facility
DAS	Data Acquisition System
DOT	United States Department of Transportation
NHTSA	National Highway Traffic Safety Administration
SWG	Signal Waveform Generator
TTM	Task Technical Monitor

3. OBJECTIVE

The purpose of this task is to evaluate all of the data acquisition channels used for recording signals in vehicle crash and sled tests conducted at contractor test facilities for the U.S. Department of Transportation, including signals from ATD and vehicle sensors. The primary and redundant channels used for the sensors **are** to be evaluated by injecting standard signals from a **SWG** furnished by the

government into the sensor input interface of each channel and recording these

3. OBJECTIVE....Continued

signals on magnetic tape. The data recorded on magnetic tape will be analyzed by government personnel at a government facility.

The evaluation testing shall be performed as directed by NHTSA (It is intended that this be performed every six months or at the beginning and the end of a test program.) at the contractor's test facilities, normally before a series of **tests that** are scheduled to be conducted (Please see Section 6, below). The evaluation testing shall also be performed on an as needed basis if a question regarding the performance of the DAS at the contractor's facilities arises during a series or part of a series of scheduled tests.

4. GOVERNMENT FURNISHED EQUIPMENT

One SWG, with three cable connectors that mate with the output jacks of the SWG, and one copy of Reference A, will be furnished to the Contractor.

5. ITEMS OF WORK

5.1 PREPARATION **FOR TESTING**

5.1 .1 SHIPPING

After unpacking the SWG and inspecting the instrument for possible shipping damage, the SWG shipping container and its foam packing should be retained in dry storage for future shipping use. When the SWG is next shipped, the Contractor shall be responsible for packing and shipping the SWG so that likelihood of damage in shipment is minimized. To accomplish this, the SWG shall be repacked in air bubble plastic wrap and polystyrene packing peanuts as it was when shipped to the contractor. Outer package labels shall specify correct orientation, "FRAGILE", and "DO NOT DROP". The use of shipping damage indicators, such as **"Drop(N)Tell",** is required.

5.1.2 CABLE PREPARATION

After receiving the SWG, the Contractor shall assemble the cabling necessary to connect the SWG outputs to the sensor output/signal conditioner input interfaces.' The Contractor shall supply the connectors that mate with the Contractor's signal conditioner inputs (or umbilical cable, as appropriate) and the wire or cable necessary to transmit signals from the **SWG** to the signal conditioner inputs. The Contractor shall verify that the **SWG** input power marking is appropriate for the available local power.

5.1.3 SWG PERFORMANCE CHECK-OUT

The Contractor shall check-out the SWG performance by displaying each waveform and time reference output on a storage oscilloscope (of which the amplitude display has been calibrated to ± 3%) and comparing the displayed

5. ITEMS OF WORK.. . .**Continued**

waveform. with Figure 5-l in Reference A. If significant differences such as loss of signal output from one or more channels, differences between positive and negative amplitude peaks greater than ± 5%, or irregularities where straight lines are shown in Figure 5-l are observed, the Contractor shall call the TTM.

The Contractor shall notify the TTM of the test schedule at least two weeks prior to start of test in case the Government desires to witness the test.

5.2 TESTING

5.2.1 OPERATING ENVIRONMENT

The SWG shall not be operated outside the environmental limits of -10°C to 50°C and relative humidity of 0% to 94%. The SWG shall not be in contact with water, ice, or snow.

5.2.2 SWG to DAS CONNECTIONS

The ± 100 mV output level ("piezo resistive" setting) signals from the SWG shall be connected to the facility instrumentation and DAS so that these signals pass through both the signal conditioning electronics and the crash or sled test umbilical cable, in the same sequence as is used in vehicle crash or sled testing. If the signal conditioners on any channel are designed to handle only lower level signals, resistive shunts shall be installed at the instrumentation interface to reduce the SWG signal voltage level to the full input range of the channel under test. The SWG output impedance is 348 Ohms.

In cases where the signals from two or more channels are combined during later processing, such as driver head x, y, and z accelerations, the channels used to collect these data shall be tested simultaneously. The channel used for the x-axis signal shall receive a "Group 1 waveform" input (SWG channels 1, 2, 3, 4, 9, 10, 11, and 12). The channel used for the z-axis signal shall receive a "Group 2 waveform" input (SWG channels 5, 6, 7, 8, 13, 14, 15, and 16). The channel used for the y-axis signal may be tested with either waveform input.

Each time waveform data is recorded, one channel of time synchronization data shall be recorded. The channel used for the time synchronization data shall be capable of accepting and recording a "TTL" pulse (0 to + 5V), 10

milliseconds wide. It is expected that this would be the channel or channels used by the Contractor to record “time zero” signals during vehicle crash and sled testing.

The Contractor shall set up to test as many channels simultaneously as is practical, up to the limit of 16 set by the SWG. The Contractor shall record

5 . ITEMS OF WORK....Continued

the identity of each DAS input channel connected to each SWG output channel.

5.2.3 SIGNAL CONDITIONERS

For each data channel to be tested, the signal conditioner used with ‘that channel for crash or sled testing shall be set up. Setup and calibration of each signal conditioner shall be performed exactly as is done for a DOT contracted vehicle crash or sled test in accordance with SAE J211 October 1988 (Reference D).

5.2.4 SWG POWER

The SWG furnished for use in the United States is wired to accept 120 VAC 60 Hz electrical power. The acceptable tolerances on 120 volt input power are 120 VAC, + 10%, -13%, and frequency variation from 47Hz to 63 Hz. The SWG furnished for use in Europe is wired to accept 230 VAC, 50 Hz electrical power. The acceptable tolerances on 230 volt input power are 230 VAC, + 15%, -10%, and frequency variation from 47 to 63 Hz. Each SWG will be marked with a label, located over the AC power input connector, that identifies the input power setting for that unit. For use with input voltage levels outside the marked range, the SWG power input transformer must be reconnected in accordance with Appendix B of Reference A.

The contractor shall apply power to SWG, signal conditioners, and DAS; and allow the SWG self-test to complete as described in Section 3 of Reference A. If a failure is indicated, the Contractor shall call the TTM.

5.2.5 TEST

The Contractor shall start the DAS recording mechanism, press and release the “RECORD” switch, and one-half to one second after the “RECORDING” light turns “OFF”, press the calibration switch for approximately one-half second or more.

The Contractor shall repeat steps 5.2.2 through 5.2.5 until all data acquisition channels have been tested. After each test run, the Contractor shall check the recorded data for anomalies, to assure that valid waveform data has been recorded fur each channel,

The Contractor shall record SWG ambient temperature at the start and at the end of testing.

5.3 DATA TAPE REQUIREMENTS

The Contractor shall provide the digitized data on a magnetic tape written in the

5. ITEMS OF WORK.. . .Continued

format specified for vehicle crash test data in References B and C. Digitizing of the data that has been recorded on analog magnetic tape shall be performed in exactly the same manner as in a DOT contracted vehicle crash or sled test. If it is possible, the digitizing process shall be initiated by the “pretime zero” pulse in the SWG time synchronization output.

During each run when waveform data are digitized, the corresponding SWG time synchronization output shall also be digitized. This time channel shall be the first in the sequence of channels to be digitized. Channels of signals that will be combined during later processing, such as driver head x, y, and z accelerations, shall be digitized during the same run. The digital data files corresponding to the time synchronization channel and each of the waveform channels shall be identified. Waveform outputs shall be scaled so that ± full scale corresponds to ± 200.

In creating the data tape, the Contractor shall provide the information required for the GENERAL TEST INFORMATION and the INSTRUMENTATION INFORMATION tape headers. The exceptions to the header code assignments of Reference B, given in Reference C, shall govern.

5.4 REPORT

A letter report on the DAS testing performed under this TTD shall be prepared. The report for this test shall include the date and time of the test, the names of the test performers and the responsible supervisor, the environmental conditions during the test a complete description of the test set-up, including a list identifying each SWG output channel connected to each DAS input channel, and a list of equipment used in the data acquisition channels tested (e.g. signal conditioners, filters, digitizing hardware).

The report shall also include plots of data from all channels tested, a description of anything that occurred during the test that might affect the data or the results of the test, and a description of any data processing algorithms (such as zero offset removal, detrending, scaling) used on the data from the digitizing through to the final recording process.

6. DELIVERABLES AND SCHEDULE

All deliverables shall be delivered to:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Mail Code: NRD-1 l-l
400 Seventh Street, S.W.
Washington, DC 20590
Attn: Ms. Randa Radwan

6. DELIVERABLES AND SCHEDULE....Continued

A. Evaluation test completion:

As directed by NHTSA.

B. Digital data tape written in NHTSA vehicle crash test format:

Within 1 week after the evaluation test.

C. Test report:

Three copies of final report two weeks after the evaluation test.

Attachment:

Data Tape Header Codes For Tests Using The SWG

DATA TAPE HEADER CODES FOR TESTS USING THE SWG

NOTE: Where any of these header code assignments differ from those presented in Reference B, the assignments of this attachment shall govern.

VERSION NO. S2

TSTREF **DDMMYYxxxx**

DDMMYY Test date
where - -

DD - - 2 digit day
MM - - 2 digit month
YY - - 2 digit year
xxxx - 4 characters for contractor's reference use

TSTTYP SWG Signal Waveform Generator test of the DAS

CURNO 001 Channel 1 of DAS
002 Channel 2 of DAS
.
nnn Channel nnn of DAS

SENTYP LL Low level signal (Strain gage)
HL High level signal (Piezoresistive)
ET Event time indicator (Code already exists)

SENLOC 01 Driver side (Code already exists)
02 Passenger side (Code already exists)

SENATT The four character code for **SENATT** from Reference B that designates the location of the sensor to which the channel under test would normally be connected.

AXIS XL Sensitive axis of sensor that would be connected to DAS channel under test is X axis.

YL Sensitive axis of sensor that would be connected to DAS channel under test is Y axis.

ZL Sensitive axis of sensor that would be connected to **DAS** channel under test is Z axis.

INSMAN Serial number of SWG used for the test

CALDAT Last calibration date for instrumentation used in data acquisition

channel tested.

DATA TAPE HEADER CODES FOR TESTS USING THE SWG....Continued

INSCOM — Commentary field. The Contractor shall identify the SWG channel connected to the DAS channel under test. The code listed below may be used to identify the SWG channel. In addition, such information as run number, amplifier, tape recorder, tape recorder channel, or anything else required to uniquely identify the DAS channel equipment shall be included. There are only 70 characters available. Do the best that you can!

SWG01	Channel 1 of signal waveform generator
SWG02	Channel 2 of signal waveform generator
SWG16	Channel 16 of signal waveform generator
SWGH1	High level signal of Group 1 waveform
SWGH2	High level signal of Group 2 waveform
SWGE1	Event time indicator (Time zero)
SWGE2	Event time indicator (Delayed time zero)
SWGI1	Event time indicator (Inverted time zero)
SWGI2	Event time indicator (Inverted delayed time zero)

APPENDIX G

NHTSA PREFERRED PRACTICE FOR METRIC CONVERSION

NHTSA is converting to the metric system of measurement. The authority for this conversion is DOT Order 1020. 1D, which was issued in response to 5 164 of the Omnibus Trade and Competitiveness Act of 1988 (PL 100-4 18). and Executive Order 12770. The agency's plan for conversion was approved by the Secretary of Transportation on October 2 1, 199 1 and were published on April 2 1, 1992 (57FR77 146 19). This preferred practice provides general guidance for the conversion, and includes a listing of the preferred units for the quantities most frequently used by the agency.

GENERAL GUIDELINES

1. Safety levels shall not be decreased as a result of a change to the metric system of units.

2. Due consideration will be given to the effects of conversion on the nation's economy, since the intent of PL 100-4 18 is to improve the competitive position of United States industry.

3. Harmonization considerations will be taken into account where appropriate. Canadian and UK standards will be used as guides were applicable.

4. Conversion will be done on a case by case basis. "Equivilant" rather than "exact' conversion will be given preference except where there is a clear safety need for an exact conversion Here equivilant means a close nominal value in contrast to exact which means a precise mathematical conversion.

5. Whenever appropriate, procedures for determining the number of signficant figures will follow the practice shown in SAE J916, May 1991. To the extent possible, test procedures developed by NHTSA's Office of Enforcement will be used to determine the implied precision required as part of the si~nificant fi~ure determination.

6. SAE J916, May 1991 will be used as the primary source for conversion factors. MST Special Publication 8 11 will be used as a backup source.

PREFERRED UNITS

The following listing shows units preferred for use within NHTSA and the acceptable abbreviation. Most of the units on this list refer to quantities used in mechanical/automotive engineering practice plus some other units normally used by the agency. For quantities used in electrical engineering, heat power engineering, lighting, or quantities not listed, see SAE J916, May 1991.

METRIC CONVERSION

WHEN MEASURING	THE PREFERRED UNITS ARE
ACCELERATION	
angular	degrees per second squared -preferred radians per second squared -acceptable
general	meters per second squared
vehicle	kilometers per hour per second
of gravity	g (Note: this is not an SI unit)
ANGLE	
general (planer)	degrees (Note: this is not an SI unit)
AREA	
vehicle frontal area	square meters
hose flow area	square centimeters
small land areas	square meters
very large land areas	square kilometers
BLOOD ALCOHOL CONC.	
general	grams per deciliter
DENSITY	
solid or gas	kilograms per cubic meter
liquid	kilograms per liter
ENERGY	
heat	kilojoules
mechanical	joules
FLOW	
mass flow rate	kilograms per second
volume flow rate for liquids	liters per time
volume flow rate for gases	cubic meters per time
FORCE	
general	newton
large forces	kilonewton

WHEN MEASURING	THE PREFERRED UNITS ARE
IMPULSE	
general	newton seconds
LENGTH	
engineering drawings	millimeters
motor vehicle dimensions	milometers or meters
vehicle crash deformations	centimeters
short land distance	meters
long land distances	kilometers
MASS	
small masses	grams
large masses	kilograms
very large masses	metric ton
MODULUS OF ELASTICITY	
general	megapascals
MOMENTS	
second moment of area	millimeters or centimeters
of force, torque or bending	newton meters
of inertia	gram or kilogram meter square
MOMENTUM	
general	kilogram meters per second
POWER	
general	watts or kilowatts
PRESSURE	
general	kilopascals
STRAIN	
general	micrometers per meter
STRESS	
general	megapascals

WHEN MEASURING	THE PREFERRED UNITS ARE
TEMPERATURE	
general use	degrees celsius
absolute	degrees kelvin
VELOCITY	
angular	degrees per second - preferred radians per second - acceptable
general	meters per second
vehicle	kilometers per hour
VOLUME	
engine displacement	liters
liquids in general	liters
other volumes	cubic meters